Report of the Director for the Session 1951—52

Management Committee: Obituaries

During the year death has deprived the University of the services of two of the most distinguished members of the Management Committee. Sir Warwick Lindsay Scott joined the Management Committee in 1946, *ex officio* as President of the Prehistoric Society, and continued to represent that Society until his untimely death in June 1952. A distinguished Civil Servant, whose conspicuous services to his country during the war were recognized by the honour conferred upon him, he was in archaeology an amateur, as were all those who founded the science of prehistory in Britain. But in his capacity as a distinguished contributor to British prehistory, both in the way of fruitful and scientifically conducted excavations and by scholarly synthetic studies, he won a place among the leading exponents of the discipline. A regular attendant at meetings and serving on several important sub-committees, he brought to the guidance of the Institute the administrative capacity and practical common sense which had been so valuable to his country in another domain. Not the least valuable of his contributions to the management of the Institute was his lively recognition of the fact that not only had archaeology as a science been created by amateurs, but that the expansion and development of archaeology in this country must always inevitably depend largely on the voluntary labours of such. Accordingly, he was always at pains to show how the University of London could and should contribute to the development of the subject by assistance rendered to such amateurs through the services of its Institute of Archaeology.

Sir Frederic Kenyon had been a member of the Management Committee since its formal constitution in 1936 and even before that had been a foundation member of the Appeal Committee which raised the funds that made the Institute possible, so that he will be remembered as one of the founders of the Institute. At all times he was available to the Institute as chairman at public meetings and in such additional capacities as he was invited from time to time to fulfil. Throughout he was a regular attendant at the Management Committee meetings until advancing years compelled him to offer his resignation at the beginning of this session. Sir Frederic Kenyon lent to the University not only the lustre of his scholarship and the authority of the high dignities this had

won him—Director of the British Museum, President of the British Academy, President of the Society of Antiquaries of London—but also the wise council and administrative experience that he had gained and exercised so notably in these varied domains of public and academic life.

After this it is pleasing in conclusion to record the public honour conferred upon a member of the Committee in the knighthood awarded Professor R. E. M. Wheeler.

Students

During the session 9 new students were registered for the Diploma in European Archaeology, Part A, making a total registration at the Institute for this Diploma of 19; 1 new student was registered for the Diploma, Part B, making a total of 3; and 1 new student was registered for the Diploma in Indian Archaeology. In addition there were 14 students registered for higher degrees, including 2 from Pakistan, 2 from India, 1 from Siam and 1 from the United States. Six full-time students registered in the Technical Department, including students from the Sudan, Nigeria, Jordan, Greece and Australia. Two students, both in the Department of Environmental Archaeology, were awarded the Ph.D. degree during the session. Four students in the Department of Prehistoric European Archaeology successfuly took the Diploma examination, 2 being awarded distinction, while 2 students obtained the Diploma in Part B, 1 with distinction.

Finally, the Lecturer in Palestinian Archaeology, Miss Kathleen Kenyon, was awarded the degree of D.Litt. in January 1952.

Lectures

In the Autumn Term three public lectures were delivered on "From History to Prehistory in Western India" on October 8th, 15th and 22nd, at 6.30 p.m., by Professors Wheeler and Zeuner, Professor H. D. Sankalia and Mr. B. B. Lal. Attendances varied from 25 to 37. During the Summer Term seven public lectures on "Archaeology and the Natural Sciences" were held at the Institute on Wednesdays at 8.15 p.m. The lecturers were: Dr. F. J. North on "Archaeology and Geology"; Professor S. W. Wooldridge on "Archaeology and Geomorphology"; Professor Gordon Manley on "Archaeology and the Meteorology of the Past"; Professor W. H. Pearsall on "Archaeology and Plant Ecology"; Professor R. J. Forbes on "Archaeology and Metallurgy"; Dr. H. Helbaek on "Archaeology and Agricultural Botany"; and Dr. M. Degerbøl on "Archaeology and Zoology." Attendances varied from 57 to 83, with an average of 70.

In addition to these regular courses of public lectures, on the occasion

of two visits to this country Professor l'Abbé Henri Breuil very kindly agreed to deliver two lectures at the Institute in October and in May. Though both lectures were arranged at short notice, the attendances were in each case most gratifying.

At the request of the Museums Association a special intensive course for students working for their Diploma was provided at the beginning of Summer Term. In addition to lectures and demonstrations given by members of the Institute staff, Mr. Grimes, Director of the London Museum, and Drs. Oakley and Swinton, with the kind permission of Mr. Edwards, Keeper of Geology in the British Museum (Natural History), were good enough to demonstrate the methods of recording, conservation and display used with such success at their museums.

Collections and Exhibitions

The Institute's collections have been enriched during the session by small but useful donations from the Archaeological Research Committee and from Mr. W. H. Hillburgh, F.S.A.

During the session exhibitions were arranged to illustrate "Archaeological Traps," "Do's and Don't's for Archaeologists," the results of recent excavations in India, Near Eastern trade in the Bronze Age, the work done by students in the Technical Department, and "Archaeology and Geology" and "Archaeology and Botany," while Major E. Beddington Behrens kindly lent for display a type series of the relics recovered from the mesolithic "pit-dwelling" on Abinger Common.

Archaeological Research

The Lecturer in Palestinian Archaeology, Dr. Kathleen Kenyon, was granted by the Management Committee leave of absence for Spring Term in order that she might direct the excavations of the British School in Jerusalem at Jericho. The results she obtained were of quite exceptional scientific importance and received excellent publicity in the Press. Professor Codrington, too, had leave of absence for most of the session, which was profitably devoted to a journey to India through Persia and Afghanistan. A preliminary account of some results of his researches will be given at three public lectures at the Institute in October 1952. Equally important in their way were excavations and explorations directed by other members of the staff and students during their vacations: by Professor Mallowan at Nimrud, Professor Wheeler at Stanwick, Mr. Nicholas Thomas at Dorchester (Oxon), Professor Childe at Quoyness (Orkney), Miss du Plat Taylor at Pigadhes (Cyprus).

The work of the staff and students in the Department of Environmental Archaeology is described in the report of that Department, but special mention

should be made of an important result obtained by one of the workers enjoying the hospitality and services of the Institute. For Mr. C. D. P. Nicholson's patient work on piecing together the crumbling fragments of the fresco from the Roman villa at Lullingstone was rewarded by the discovery of Chi Rho monograms and other designs that suggest that the building may have contained the oldest Christian place of worship yet recognized in the British Isles. In the publication of this sensational discovery the contribution of the University of London's Institute was generously acknowledged.

Report of the Department of Environmental Archaeology

Teaching

The attendance at the first-year course in Environmental Archaeology rose to 23. Since the capacity of the classroom is only 12, it was necessary to add a second row of chairs which deprived about half the number of students of working space at the table. This condition is most unsatisfactory but inevitable since no other room in the building is equipped for holding this course. The course on the Stone Ages of Africa and Asia has been attended by 12 students. In addition to seminar work and lectures on the African and Indian material contained in the teaching collection, special lectures in Indian, Near Eastern and African subjects were kindly given by Colonel D. H. Gordon, Mr. R. Summers and Dr. J. Waechter. The course on Palaeolithic Typology (advanced work on collections) was attended by 4 students. Two out of 3 Ph.D. students completed their courses. In addition there were 3 research students under Regulation 21 (iii) and special courses were arranged for 4 other students.

Thirteen lectures were given by members of the staff outside the Institute, of which eight were given in other colleges of London University and other universities. Four lectures with experiments demonstrating methods of dating the past were given at the Royal Institution.

Students were taken out on excursions on four occasions, the average attendance being 27. One of the excursions was joined by Professor Hollingworth of University College and 20 members of the Greenough Club. On these excursions an attempt was made to show a number of sites ranging from the Lower Palaeolithic to the Roman Period and illustrating the connection between man of the various periods and his environment.

Research

The facilities of the Department were improved by the acquisition of a new chemical balance of high sensitivity, which is necessary for the pipette method of mechanical analysis. Much time was devoted to a careful comparison of the three methods of mechanical analysis, the Atterberg, pipette and hydrometer methods. In order to speed up the preparation of samples a mechanical stirrer was bought which reduces dispersion of the samples from about 28 hours to 15 minutes. Some wear of the grains was observed, though it appears not to be sufficiently serious to interfere with the results obtained. In work on the hydrometer method we enjoyed the help of Dr. R. Glossop and his staff at Soil Mechanics Ltd., and Professor A. W. Skempton, of the Imperial College of Science and Technology, who gave very valuable advice. It has thus become possible to investigate the mechanical composition of samples from excavations much more rapidly than formerly. Similarly, the methods of determining humus, phosphates and other chemical constituents have been standardized and a system of investigating samples developed which can be applied to most materials submitted. Form sheets have been developed on which the results of investigations are entered in accordance with the practice of many other laboratories. This helps not only in the investigations in the laboratory but makes the laboratory work more intelligible to students and the enquiring archaeologist.

Research on Sites

Apart from sites studied specifically in the interests of research work in the Institute, nine requests to study soil and six requests to identify materials and bones were complied with during the year. In all 762 specimens and samples were examined. Among the sites studied were sections from Gorham's Cave, Gibraltar (Mousterian and Upper Palaeolithic; J. Waechter), barrow soils from Canford Heath (P. Ashbee), the Palaeolithic loess section of Achenheim, Alsace (P. Wernert, Strasbourg) and the polished stone axe site of Brahmagiri, Mysore (M. Seshadri).

Field Work

The survey of Palaeolithic sections in France and western Germany was continued. Achenheim and the Schaffhausen area of Switzerland were revisited and the type sequence of Penck in the foreland of the Bavarian Alps was visited under the guidance of Dr. B. Eberl. With the aid of a grant-in-aid from the Central Research Fund the survey of Palaeolithic sections was extended to Algeria and Tunisia.

F. E. Zeuner.

Report of the Technical Department

THIS year 54 students attended the various courses given by the Department, 8 of them being sent by their museums.

A number taking the full-time course had come from overseas, and, as an experiment, they were taken to visit various museums including the London Museum, British Museum and Natural History Museum to study methods of display and the use of plastics, etc. This proved a great success.

Mr. Edwards, the Keeper of the Geological Department of the Natural History Museum, very kindly allowed a party to be taken over the workshops where Mr. Parsons and Mr. Mead demonstrated methods of casting and the use of plastics in preservation.

The Department is also greatly indebted to Dr. Plenderleith, of the British Museum Research Laboratory, who, with Dr. Moss and Mr. Maryon, devoted a whole afternoon to taking parties round the laboratory where special exhibits illustrating the work done were laid out.

Mr. Grimes, of the London Museum, gave a preliminary talk to the students on the problems of exhibiting material in a building not constructed for the purpose and then spent the evening taking them round the collections.

The films on the restoration of pottery and the treatment of metal objects made in the Department last year have been most useful in teaching and were also used at lectures given in Reading at the Museums Association training week, in Brighton to the Sussex Archaeological Research Committee and at Northampton to students at a training excavation at Hunsbury under Mr. R. J. C. Atkinson.

A short course was given to the Museums Association diploma students. The Institute's films and a film by M. Albert France-Lanord, Conservateur au Musée Historique Lorrain, Nancy, on the cleaning of Merovingian inlaid buckles were shown and two other afternoons and evenings were devoted to demonstrations and discussions of methods of preservation. The Department was also asked by the City Museum of Leeds to give what help it could to one of their staff who wished to study methods of preservation. Although he was only able to spend two days in the Department the museum expressed satisfaction with the very concentrated course provided.

It has been possible to undertake some outside work but the Department has been fairly fully occupied in treating material brought in by the Institute's staff from Stanwick, Nimrud and Jericho. The latter site yielded some very interesting wooden objects in a carbonized condition and Miss Western remained to help voluntarily with these. She also did some excellent work reconstructing and cleaning some ivories from Nimrud for Professor Mallowan. IONE GEDYE.

Report of the Photographic Department

Teaching

In this session, in addition to the usual technical and individual students, there were no less than 16 students registered for the Diploma who had to take the Photographic Course. This steady increase in the number of students made it necessary to split up the practical part of the Course into three sections, so a total of 36 hours teaching had to be devoted to Diploma students alone. There were, in addition, three individual students and the special course for the Museums Association's Diploma students, of whose 25 hours' work at the Institute, five were occupied by photographic instruction.

During the Second Term, an experiment was tried in the form of a visit to the Kodak factory at Harrow and since this visit had to be arranged in "out of term" hours, it was refreshing to note that all students attended. At this factory, students were shown and had explained to them the manufacture of films, plates and paper. The camera assembly factory was also viewed, and the visit closed with a brief lecture on the history of photography and kindred processes and the viewing of the Photographic Museum where cameras and lenses from Daguerrotype to the present day were seen and demonstrated. Kodak Ltd. were duly thanked for the welcome given and for the interest they had shown in placing two demonstrators at our disposal, and it is hoped to make this a yearly visit.

At the end of the technical students' course, a test of ability was set and the resulting productions were exhibited. In order to assess the work in its relation to quality, originality and finish, the secretary of a well-known photographic society was asked to judge the work and marks were given, the highest being 83·3 per cent and the lowest 62 per cent.

This year the Department received only two visits from outside groups. In addition to the Kodak visit, the Instructor was invited to Hunting Aero-surveys where a day was spent observing a great deal on their latest methods of air-survey and map-making and seeing the latest makes of air cameras and processing equipment.

The Photographic Instructor was invited to give three public lectures on the application of photography to archaeology to extremely good audiences, two of 90 and one of 210, Bath being the farthest point away from headquarters.

Eight members and persons associated with archaeology sought advice on photographic matters not connected with any course, and help and advice was given to two expeditions.

PRODUCTION

Included in the production figures given at the end of this Report is the illustrating of two theses by photography, one averaging 140 prints and the other 206 prints.

During the Easter recess the studio, darkroom and photographic office were taken over by builders, and small repairs were executed and the whole Department cleaned and given two coats of distemper. This has considerably brightened the photographic quarters.

The Department was called upon to attend five major excavations.

PRODUCTION

1,674 lantern slides.
3,425 prints and enlargements.
133 hours with the projector at lectures.

NEW EQUIPMENT

1 Aldis Miniature Projector.
"750" filter with a 6 in. projector lens and transformer.
1 new Gandolfi camera stand.
1 new safelight for darkroom.
2 new large duckboards for darkroom.
4 new matting strips in studio.
Sundry repairs to students' cameras.

M. B. COOKSON.

Library Report

THE Library has been more frequently used during the past session than ever before—on occasion, only one or two seats have remained vacant, in spite of the addition of four new desks. During the summer the stage was removed, giving extra seating space, and greatly improving the general appearance of the Library. Two small bays of shelving were also added.

Work continued on the Site and Subject Indexes, covering a certain number of journals.

In spite of the restrictions on loans, the number of lantern slides used outside the building was almost doubled, due to regular series of lectures given by senior students. The revision of the catalogue progressed well, and a Subject Index was prepared for the revised sections.

Miss Ilid Anthony left at Christmas to take up an appointment at Bath Museum. Miss V. Seton Williams took charge of the slide collection for the remaining six months of the session.

Miss Talbot was granted leave during the Spring Term to assist in the Jericho excavations.

Volumes added to the Library	282	Lantern slides added to the Library	869
By purchase	161	Volumes bound	227
Presented	98	Volumes lent	2,613
Exchanged	23	Highest month: October	365
Pamphlets added to the Library	204	Lowest month: September	81
By purchase	11	Volumes borrowed from outside libraries	153
Presented	189		
Exchanged	4	Lantern slides lent	2,547
Periodicals added to the Library	272		

The following have presented books, periodicals and lantern slides to the Library:— Algeria, Direction de l'Intérieur et des Beaux Arts, Athlone Press, D. J. Batten, G. C. Boon, British Archaeological Association, C.I.B.A. *Review*, Professor Childe, D. Clarke, Dr. I. Cornwall, Mrs. Cotton, J. D. Cowen, J. M. Cruxent, Miss M. Eates, Ecole Française d'Extrême Orient, Per Fett, Dr. Henry Field, Dr. H. Godwin, Goldsmiths' Librarian, L. V. Grinsell, Sir Thomas Kendrick, Dr. K. M. Kenyon, Dr. H. Z. Kosay, A. D. Lacaille, Dr. B. B. Lal, Leicester Museum and Art Gallery, Miss D. Marshall, Mr. V. Molesworth-Roberts, Dr. H. L. Movius, National Museum of Scotland, Miss T. M. I. Newbould, H. T. Norris, Col. A. do Paço, Miss F. M. Patchett, Pennsylvania University, E. Pyddoke, Miss K. M. Richardson, Royal Anthropological Institute, Dr. Sankalia, Dr. Senyürek, Serviços Geológicos de Portugal, P. L. Shinnie, Dr. Stekelis, J. R. Stewart, Miss G. Stretton, Sudan Antiquities Service, Miss du Plat Taylor, Dr. A. D. Trendall, Miss O. Tufnell, M. Ventris Venzo, Victoria and Albert Museum, Sir Mortimer Wheeler, Miss V. Seton Williams, E. S. Woods, Dr. Zeuner.

JOAN DU PLAT TAYLOR,
Librarian.

Notes on the Stratigraphy of the Magdalenian

By F. E. Zeuner

The Magdalenian has recently undergone a kind of rejuvenation. There has been a tendency to reduce the date of its beginning, but conspicuous have been the voices that postulate an extension of this culture into the Alleröd period. Yet others desire both to shorten the Magdalenian and to place it as late as possible. These various views are based on evidence mainly from newly discovered sites. It is only natural that new discoveries cast shadows over the finds made previously, and these are apt to be forgotten. In fact, however, the latter have lost nothing of their validity.

Confusion is often caused by a shift in the meaning of technical terms. In the case of the Magdalenian, the typological definition has not remained the same, and the geological nomenclature used for the relevant climatic phases has undergone changes also. It seems worth while to survey the position, not so much in order to arrive at new conclusions but to see the problems involved in their correct light (Fig. 1).

The traditional classification of the Magdalenian as worked out by Breuil (1912; 1951, p. 176) is primarily based on the bone industry of French and Spanish sites. The stone tools show in fact a marked decline after the climax reached in the French Solutrean or even compared with the Gravettian. The blades used in the early Magdalenian are often heavy, advantage is taken of chance shapes, and the character of the assemblage varies considerably with the raw material. From the Magdalenian IV onwards, however, where the harpoons appear, the stone tools assume a Gravettian character, with lateral burins *à retouche transversale oblique ou concave* and with Gravettian points. In the fully-fledged late Magdalenian, Breuil distinguishes two facies, one of the Pyrenees and the other of Périgord, the first with large and little-retouched blades, the second with short and strongly-retouched tools, including small round scrapers and *lames de canif* with curved backs. Both facies have, however, in common the parrot-beak burin, and in the Dordogne shouldered and pedunculate points occur in addition.

In North Belgium, Holland and North-West Germany a number of localities has recently been discovered which Schwabedissen (1951) and others regard as Magdalenian. Representative sites are Donkerbroek in North Holland, Wustrow a. d. Jeetzel and Rissen in North Germany. These industries are characterized

by an abundance of backed blades, Gravettian points, and blades with curved and blunted backs, which in some cases may be described as large lunates. This group of sites is undoubtedly typologically different from the Hamburgian

FIG. 1 Distribution of Late Glacial Industries

which is characterized by shouldered points and the pseudo-awl (*zinke*). Narr (1951) has given an instructive sketch-map which shows that the Hamburgian sites are confined to North-West Germany and Holland, whilst the industries containing Gravettian-like tools occur to the south, although a few sites pene-

trate the Hamburgian domain. It is, however, much more difficult, one is inclined to say at present impossible, to differentiate, among the industries containing Gravettian-like tools, facies which may be regarded as either Magdalenian or Gravettian. Where a lithic industry of a Gravettian character occurs in association with a bone industry comprising harpoons and other items which, by definition, are Magdalenian, such an industry may rightly be described as Magdalenian. But this applies only to certain localities in the south and west, such as the Kesslerloch in North Switzerland, the Petersfels in South-West Germany and Andernach in Western Germany. The identification as Magdalenian of sites like Rissen is based on the resemblance of their stone industry to those of sites that have supplied a bone industry in addition.

On the other hand, there is no *a priori* reason why these sites should not be comparable with the eastern Gravettian, for instance. From the typological point of view, therefore, the character of these sites is best described as Upper Palaeolithic of a Gravettian facies and clearly different from the Hamburgian group. Whether they will have to be referred to the Magdalenian or the eastern Gravettian complex remains to be seen. Either alternative is possible, but neither is more likely than the other, so far as available evidence goes.

The stratigraphical age of this final Palaeolithic of North-West Central Europe is still somewhat uncertain. The only site providing a section is Rissen near Hamburg, where Schwabedissen found his "Magdalenian" covered by 4 ft. of dune-sand, on which an Ahrensburgian horizon occurred. This in turn was covered by another 4 ft. of dune-sand. The section shows clearly that the Rissen Palaeolithic is older than Ahrensburg. How much older, however, is impossible to say, since the underlying strata are dune-sands of uncertain age and middle Pleistocene deposits. Schwabedissen employed a typological argument in order to narrow down the age of his Rissen-"Magdalenian." The finds from this horizon included one Lyngby point. Lyngby points occur also at the Danish site of Bromme (Mathiassen, 1946), which on pollen-analytical evidence belongs to the Alleröd phase, and Schwabedissen considers that this indicates an Alleröd age for the Rissen Palaeolithic. Lyngby points, however, occur at Lyngby itself in deposits of the Danish pollen zones III-IV, i.e., Younger Dryas time or somewhat later. Furthermore, pedunculate points of various types occur in numerous Upper Palaeolithic industries, beginning with Font Robert. In the late Magdalenian of the Dordogne a type occurs which resembles the Lyngby point somewhat closely. Whilst this might be used as an argument in favour of a Magdalenian character of the Rissen industry, it does not date the late Magdalenian as Alleröd, since similar points occur as late as in the Preboreal.

The idea of an Alleröd age of the north-west central European final Palaeolithic of Gravettian facies is, however, by no means impossible. Rust

(1948) found that at Bornwisch near Hamburg two cultural horizons of this group occurred in the Alleröd beds of a lake.

Difficulties arise, however, when an attempt is made to place the south-western Magdalenian in the Alleröd phase. That typological comparison of the lithic industries is useless in this connection has been pointed out already. A serious attempt has, however, been made by Gross (1951) to prove this point in the case of Andernach on the Rhine, a site with a typical Magdalenian bone industry of a late type (including harpoons and needles) and a lithic industry of Gravettian facies comprising many coarsely-made tools together with some microlithic elements. Andree (1939) stresses, however, that this Magdalenian cannot be regarded as very late. The site is covered by pumice beds of the Postglacial volcano of the Laacher See in the nearby Eifel Mountains. In view of the importance of the chronology of this site, the writer visited the area in 1950 and 1951.* Samples were collected and investigated in the Department of Environmental Archaeology with results which differ from the views put forward by Gross. This author was at a grave disadvantage in not being acquainted with the important paper by Frechen and Straka (1950) on the pollen-analytical date of the volcanic eruptions. Furthermore, he states that no station of the typical Magdalenian of West and South Germany has yet been fitted into the geochronological time-scale. Yet a detailed work by Peters and Toepfer (1932) on Petersfels has given us important chronological information on that site. Finally, Gross misinterprets the significance of the loess-loam in the Andernach section. The section which yielded the implements has been built over and is no longer available. Through the kindness of Dr. J. Frechen of Bonn I have been supplied with a copy of the original section as described by Schaaffhausen in 1888. It is reproduced here in view of its importance (Fig. 2). I have also been able to visit exposures in the vicinity of the site and in particular to compare the recorded section with that exposed in the lava quarry of Niedermendig (Fig. 3), where exactly the same sequence of beds occurs as is reported by Schaaffhausen from Andernach.

According to Schaaffhausen the base of the section at Andernach consists of a lava surface with numerous pockets and loose blocks. The pockets and spaces between the blocks were filled with a loamified loess. Throughout this loess the implements occurred and bone and antler artifacts had been attacked by weathering processes. The loess-loam, moreover, contained some humus. Fresh, unweathered beds of pumice constituted the remainder of the section. This combination of circumstances admits only one interpretation, namely that the implements are contemporary with the formation of the loess and that the loess was *subsequently* incompletely weathered. To consider the implements as

* The support of the Central Research Fund of London University, which enabled the writer to visit many sites discussed in this paper, is gratefully acknowledged.

contemporaneous with the weathering (as done by Gross, *l.c.*, p. 167) is pedologically a difficult matter, since the bones would have had to lie on the land surface where they would have disappeared completely in a short time. The fact that they occurred throughout the loess (to a depth of about 1 m.) and that they were corroded by weathering processes but not destroyed, can only mean that the weathering followed the deposition of the loess deposits with its prehistoric industry. The sequence of geological events at Andernach, there-

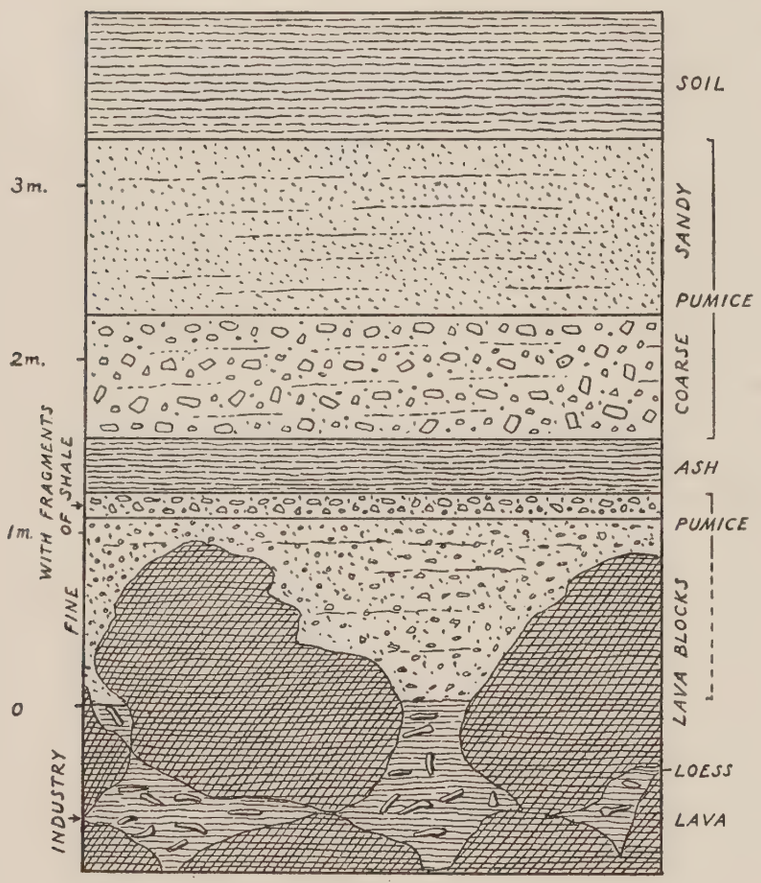

FIG. 2. Andernach section, after Schaaffhausen.

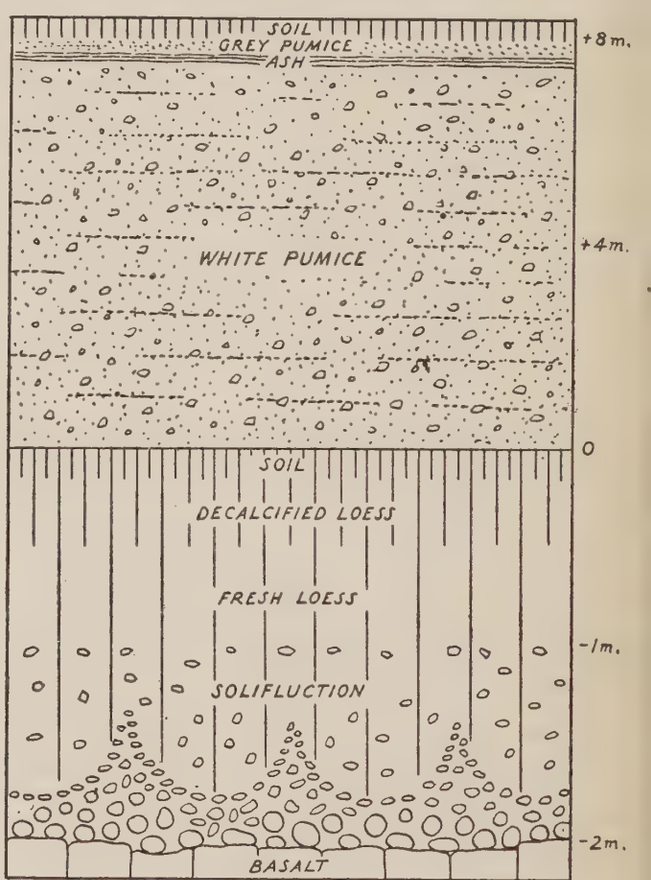

FIG. 3. Section at Niedermendig.

fore, is (1) deposition of loess with the Magdalenian industry, (2) a period of weathering, (3) the eruptions of the Laacher See volcano and deposition of the pumice beds. At Niedermendig, whose famous lava became an article of export from the Neolithic onwards, an excellent section exists which enables one to recognize the weathering period in the clearest possible manner. Its lowest part is composed of lava with a rough surface covered by loess. The lower portion of the loess is intimately mixed with spheroidal lumps of lava, which are sometimes festooned and which increase in number and density of packing as one approaches the lava surface. This condition is strongly suggestive of a brodel soil and hence evidence of a frost climate at the time when the loess was blown in. The upper part of the loess, which attains a thickness of 1·5 m.,

is pure, pale greyish-yellow and porous and thus resembles in every respect ordinary Younger Loess.

The surface of the loess is weathered. It carries a brown soil which is about 15 cm. thick. Partial decalcification has proceeded to a depth of about 50 cm. where calcareous rootlet holes appear and continue down to a depth of 1 m. At this depth small lava fragments begin to occur in the loess, in other words the solifluction phenomena described reach to about this level. The analysis of the samples had the following result:—

	pH	$CaCo_3$	Humus
Pumice	7·0	0	0
Soil	7·1	0·7	0·7%
Loess	8·1	16·7	0·05%
Loess + solifluction	8·3	19·4	0·05%
Lava	—	—	—

No doubt can be entertained as to the nature of the brown surface layer of the loess. An alternative to the explanation of this layer as a soil might have been that it was due to the heat effect of the pumice, but this cannot be so since humus is concentrated in this layer. Although this soil has had time to develop the characteristics of a brown-earth, it is not mature, its thickness being very moderate. Decalcification has not reached the depth which is usual in Post-glacial soils, i.e. in soils which have been forming since the Younger Dryas time. It is evident, therefore, that the soil on the loess is the product of a period of temperate climate of a duration considerably shorter than the Post-glacial from the end of the Younger Dryas time onwards. The important inference to be drawn from this and other sections in the Andernach-Niedermendig area is that after deposition of this loess (containing the Magdalenian) a brief temperate period followed. This was in turn followed by the deposition of the pumice.

Frechen and Straka (1950) have been able to date the latest volcanic phase of the Eifel with fair accuracy. They investigated peat sections in or near craters and came to the following results. The eruption of the following volcanoes took place:—

Booser Maar	End of Younger Dryas time to early Pre-boreal
Weinfelder or Gemünder Maar	Middle of Younger Dryas time
Moosbruch Maar	End of Alleröd to beginning of Younger Dryas time
Schalkenmehrer Maar	End of Alleröd to beginning of Younger Dryas time

To these datings has to be added the most important of all, the eruption of the Laacher See volcano that furnished the pumice layers covering both the

Magdalenian site of Andernach and the loess at Niedermendig. The eruption, which occurred in several stages, produced ash clouds that drifted into Central Germany and have there been found in a number of peat bogs as far as east of the Hartz Mountains. These ash layers consistently proved to be of Alleröd age, and Frechen (1951) succeeded in recognizing their origin from the Laacher See by their mineralogical composition.

It is evident, therefore, that the small soil observed on top of the Younger Loess and underneath the pumice was formed in the earlier part of the Alleröd oscillation. The local vegetation of the period is known not only from pollen spectra but from trees which grew on the land surface and were killed by the falls of pumice and ash. The woods of the period appear to have consisted mainly of pine and birch. It is further evident that the Magdalenian does not belong to this forest phase during which chemical weathering took place, but to the top of the Younger Loess. It still belongs to a climate which was sufficiently cold for loess to be deposited. The question, therefore, arises, which loess this is. Local evidence does not provide a clue. In the adjacent Mainz basin, however, plenty of sections are known that show three separate Younger Loesses corresponding to three phases of the Last Glaciation. It is permissible, therefore, (and no conceivable objection can be raised) to regard the uppermost loess of the Andernach and Niedermendig area as representative of the third phase of the Last Glaciation.

The fauna of the Andernach site is said to have consisted, in order of frequency, of the following species: horse, reindeer, aurochs, arctic fox, red deer, water vole, *Mustela vulgaris*, *Mus musculus*, ptarmigan, wolf, variable hare, lynx, squirrel and a few birds.* This fauna agrees with other sites of Last Glaciation 3 age in the abundance of horse and reindeer, the absence of mammoth and woolly rhinoceros, and the presence of some woods indicated by red deer, lynx and squirrel. In favoured districts of the Rhine Valley it is by no means unusual to find a few forest species associated with the tundra and loess-steppe species. Red deer and pig for instance occur in the Younger Loess I of Wallertheim, and it is probable since Fauler's work on the loesses of the Rhine Rift that even during the maxima of the Last Glaciation, strips of woodland existed at the foot of the mountains. In considering the fauna and flora, it should not be forgotten that climatic conditions in the Rhine Valley are considerably more favourable than in other parts of central Europe.

It is thus evident that Andernach cannot be regarded as a Magdalenian site belonging to the Alleröd phase. It is older; in fact it dates from the latest phase of the loess formation. Nor are there any other sites proved as Magdalenian by their bone industry, that can be dated on geological evidence as

* In this list the burrowing species have been omitted as they could be intrusive and it is assumed that the fauna is homogeneous. In other words, it is accorded the benefit of the doubt.

later than the last phase of the Last Glaciation. It may be reiterated here that a post-LGl3 age of the final Magdalenian is conceivable, but it remains as yet to be proved.

Turning now to the earlier phases of the Magdalenian, one notices that sites of this industry are decidedly rare in the loess zone of the periglacial area. They are not entirely absent as is shown, apart from Andernach, by Munzingen in Baden. On the whole, however, the Magdalenian is a cave and rock-shelter culture which is conspicuously concentrated in the hilly districts of North Spain and the Pyrenees, the Dordogne and Central France, and the Jura Mountains from France through Switzerland into Germany. The Jurassic hills of Poland (Jerzmanowska Cave, for instance) mark the eastward extension of this area. Compared with cave sites and rock-shelters, Magdalenian open-air stations must be regarded as rare. The ecological problems involved in this will be discussed later on; it is first necessary to settle the chronological question. For this purpose not many sites are available, partly because many were excavated at a time when the subdivisions of the Last Glaciation had not been recognized so that the stratigraphical records are not sufficiently detailed. This applies to the vast majority of Spanish, French and German sites.

A site of great potential significance is the Castillo Cave in northern Spain, excavated in 1910–14 by Obermaier, Wernert and others. An early and a late Magdalenian are present, separated by an almost sterile clay layer ("loam with boulders" in Burkitt, 1949, p. 22). The late Magdalenian is covered by a stalagmite horizon which is followed by the Azilian. There are one (Obermaier, 1925, p. 162) or two (Burkitt, 1949, p. 22) stalagmite horizons above the Azilian. It is difficult to interpret this section from the climatic point of view. The fauna of the early Magdalenian contains some reindeer besides a large amount of red deer, whilst in the late Magdalenian the reindeer seems to have disappeared. The significance of the stalagmite horizon in this cave is obscure. Nevertheless a reinvestigation of the extraordinarily complete sequence of this cave would yield useful results.

In France, it has generally been the custom to base the stratigraphy on prehistoric typology and on fauna, whilst the petrological composition of the strata has often not even been mentioned. At La Madeleine in the Dordogne (Capitan and Peyrony, 1928) the lower level (with middle Magdalenian) is essentially a sandy flood deposit. Its fauna is characterized by temperate species together with horse and reindeer. The middle level suggests that the floods of the Vézère River were less pronounced and that instead a brick-red loam was deposited together with other material. This might suggest some chemical weathering, but should not be regarded as conclusive since it was not possible to obtain suitable samples when the site was visited in 1949. The fauna of this layer resembles that of the preceding one. Horse, however, has

become rare, though reindeer is abundant. Wooded tracts are suggested by the presence of lynx and wild pig. The industry is characterized by single-row harpoons with long barbs. This level is separated from the upper cultural horizon by a sterile angular gravel, possibly suggesting a recrudescence of the cold climate. Then follows the upper level composed of brown soil matter with numerous limestone fragments. Its fauna is difficult to interpret, being a mixture of cold elements like *Lagomys*, reindeer and possibly chamois, with others of a temperate type like wild pig, red deer and European hare. Its industry is characterized by the double-row harpoons of the Magdalenian VI. This horizon is covered by several metres of earth and rock fragments which have accumulated since the last occupation of the site. One notices that no clear picture can be obtained from the section and fauna, and this applies to practically all French sites in spite of their enormous wealth of prehistoric objects. It is possible that the intensity of the occupation has in many cases affected the characteristics of the strata to such an extent that they are not easily interpreted climatologically. Much can be done, however, while the excavation is in progress, and it is to be hoped that the site of Angles-sur-l'Anglin, at present being excavated by Mlle. de Saint Mathurin and Professor Garrod, will yield the necessary evidence to the experienced eye.

Before leaving France, attention should be drawn to an interesting attempt by Lacorre to evaluate the fauna of a large number of Palaeolithic sites of South-West France in a semi-statistical manner. The table which he published (1937) does not contain sufficient numerical data to demonstrate a result of this work which M. Lacorre very kindly explained to me when I visited Les Eyzies. It is that the early and late Magdalenian (II-III and V-VI) have a colder aspect than the middle (III-IV). There is some unpublished evidence available from soils in rockshelters in France and northern Switzerland which supports this view.

The area around Lake Constance has provided the most reliable evidence for the stratigraphical position of the Magdalenian that has so far come to hand. The three sites of Schweizersbild, Kesslerloch and Petersfels were visited in 1950 and the finds studied in museums. The Kesslerloch is known to have contained a sequence from early to late Magdalenian, whilst the two others were occupied in single phases only.

The typological character of the Kesslerloch finds has recently been re-considered by Tschumi (1949), but the excavation which provided the evidence was that of Heierli (1907). The section of the cave comprises a yellow "culture-stratum" which has been subdivided into three horizons, I (the uppermost), II, and III (the lowermost). Horizon II was slightly greyer than I and III, a difference which may have been due to a somewhat higher content of organic matter, derived either from occupation debris or from a certain

amount of chemical weathering. Either interpretation is consistent with the remainder of the evidence. It is important that Heierli succeeded in establishing this division which throws some light on the great wealth of material obtained by earlier excavations. Horizon III of the "yellow culture-stratum" contained no harpoons, but numerous bone and antler javelin-heads were present. It represents an early Magdalenian, not later than Magdalenian III of the French classification. In the middle horizon there appeared an engraved *bâton-de-commandement*, needles and the remains of a single-row harpoon. The uppermost horizon (I) contained a characteristic late Magdalenian, comprising a double-row harpoon. R. R. Schmidt, Tschumi and others agree in regarding this horizon as typical late Magdalenian. As to the middle horizon, it is undoubtedly an intermediate stage of the Magdalenian, but whether it should be compared with the French Magdalenian IV or V is difficult to say.

As long ago as 1919 Soergel pointed out that the middle horizon is characterized by a slightly warmer fauna, musk-ox and woolly rhinoceros being absent, whilst beaver and roe deer occur. He claimed that in the course of the Magdalenian occupation of Kesslerloch, the climate was cold at first, then slightly milder (with reindeer persisting!) and then colder again. In this evidence for a mild oscillation of a rather weak character in the course of the Magdalenian, the Kesslerloch does not stand alone. That evidence to this effect is forthcoming in France has been pointed out already. Of other well-published sites, the Petersfels is the most important. The Kesslerloch, as well as the Petersfels, have been fitted into the glacial chronology of the northern Alps. This was possible because they are directly associated with glacifluvial deposits. The association was first pointed out by Schmidle (1914) and has since been elaborated in detail by Kimball and Zeuner (1946). The basal deposit of the cave is a glacifluvial gravel belonging to the Fulach Terrace of the Würm 2 stage of the Schaffhausen area. The gravel passes upwards into flood loam, during the formation of which Magdalenian man appeared. It is evident, therefore, that the occupation cannot be earlier than the retreat of Würm 2 from its maximum stage, and the association of the cultural horizon with this flood loam suggests that the occupation followed the beginning of this retreat almost immediately. This opinion was clearly expressed by Meister (in Heierli, 1907, p. 55). The fact that a climatic oscillation is shown in the fauna accords well with the presence of the Singen Moraine of Würm 3 age at a short distance from the Kesslerloch. The re-advance of Würm 3 has, therefore, been made responsible for the apparent recrudescence of the cold climate in the late Magdalenian level.

The Petersfels (Peters, 1930) contained an industry of an age not earlier than Magdalenian IV, possibly as late as Magdalenian VI. Without doubt it contained a single level only. Garrod (1938) states that the javelin-points and

the *bâtons-de-commandement* bear conventionalized engravings of fish and decorative motives, some of which "closely resemble types which in France are usually associated with Magdalenian IV." Other objects, however, may be regarded as typically late Magdalenian, namely batons with a row of holes and a *bâton-de-commandement* with naturalistic engravings of reindeer. There is also a pendant with a row of horses' heads, according to Garrod executed in the style of Magdalenian V-VI. Finally, a double-row harpoon with angular barbs appears, which would be consistent with Magdalenian VI. Typologically, therefore, it is not easy to define the Petersfels industry, except in so far as it is a late Magdalenian. The survival of the Magdalenian IV characters indicates an age slightly earlier than that of the upper horizon of the Kesslerloch. On the other hand, the presence of late Magdalenian double-row harpoons makes it impossible to classify Petersfels as Magdalenian IV. One thus comes to the conclusion that it is intermediate between pure IV and pure VI, and the geological sequence bears out this as correct.

The Petersfels Magdalenian rests on a frost-weathering talus formed during Würm 2, in a glacifluvial valley first excavated in Würm 1. This was established by Toepfer (in Peters and Toepfer, 1932). The talus is covered with a thin layer of soil, evidence of interstadial conditions, which has been discussed repeatedly (Toepfer, *l.c.;* Kimball and Zeuner, 1946; Zeuner, 1946, 1952). The occupation followed closely a period of soil formation, and passes into another frost-weathering talus with its Postglacial soil on top. Toepfer, knowing that the lower solifluction represented Würm 2, concluded that the upper solifluction level was contemporary with the Singen Moraine or Würm 3, and the Magdalenian occupation of this site would have taken place when, at the end of the interstadial Würm 2/3, the climate was becoming colder again. Its stratigraphical position thus agrees exactly with its typological character.

These sites have made it highly probable that, in the course of the evolution of the Magdalenian, there occurred a climatic oscillation, approximately in middle Magdalenian times. It was of a weak character, the reindeer and other cold species persisting throughout, though there is plenty of evidence of an increase of the forest at the time. The Magdalenian phase VI is associated with a phase of climate distinctly colder than that of the middle Magdalenian. In northern Switzerland and adjacent Baden, these climatic oscillations have been correlated with terraces of the Rhine. This evidence shows quite definitely that the cold phases of the early and late Magdalenian, respectively, are those of the Gottmadingen Moraine and the Singen Moraine, i.e. of Würm 2 and Würm 3 of that area.

These climatic phases cannot be regarded as minor events, for each of them, though composed of several morainic "wreaths," is connected with an independent terrace of the Rhine. The same applies to the Würm 1 stage of

Schaffhausen which lies, at the Kesslerloch, only about one kilometre in front of the outer Würm 2 moraine. Nevertheless, the two are joined to quite different river terraces. In order to test the regional validity of this sequence, a visit was paid to the Iller-Lech area east of Lake Constance, which was covered by a large glacier adjacent to the Rhine glacier. Here, Eberl (1930) recognized again three groups of moraines connected with three independent river terraces, the only difference being that Würm 2 was slightly larger than Würm 1, its moraines lying six kilometres outside those of Würm 1. The chronological sequence and connection with the glacifluvial system is nevertheless clear. Evidently the ice margin of Würm 2, which on the Rhine glacier at Schaffhausen lay within a kilometre of the inner Würm moraine, succeeded in trespassing over the Würm 1 moraine of the Iller-Lech glacier. Such local differences are to be expected. The separate status of Würm 3 is confirmed in Eberl's area.

It will have occurred to the reader that a possible alternative to the chronology here set out might be to substitute the Younger Dryas time for Würm 3 and thus to shift the entire Magdalenian into the period from the maximum of the third phase of the Last Glaciation through the Alleröd oscillation to the phase of the Central Swedish Moraines. This alternative will appeal to those who prefer to make the Magdalenian as late as possible. It was tenable, however, only until 1947 when Inge Müller published an important work on the vegetational history of the western part of Lake Constance. Firbas (1949, p. 77) has drawn attention to the great importance of this work, in which the Alleröd oscillation was established as a pine phase followed by a birch period corresponding to the Younger Dryas time of northern Europe. This in turn was succeeded by a pine phase corresponding to the Preboreal, whereafter the sequence is more or less the usual one. It has apparently not yet been noticed that the importance of this work is greatly enhanced by the position of the sites which lie on the Mainau Island and at Radolfzell on the western extensions of Lake Constance. Both are inside the basins of the Stein-Singen Moraine, which, therefore, is older than the Alleröd oscillation. It is separated from this oscillation by an initial treeless willow phase and a birch phase during which forest formation appears to have begun. In other words, the Stein-Singen phase is not inconsiderably older than the Alleröd oscillation, and this discovery rules out the alternative of Würm 3 of the Schaffhausen area being the equivalent of the Younger Dryas time. The chronology suggested in the present paper is thus confirmed by pollen analysis.

Exactly the same result is obtained when the chronology of the Younger Loess is taken into consideration. In most areas of western and central Europe as far as Austria, two Younger Loesses have been distinguished for many years, separated by a soil of moderate thickness. The Younger Loess as a

whole rests on the Older Loess and is separated from it by a soil horizon of considerable thickness and often of a different character. It was formed, of course, in the Last Interglacial. More recently, however, plenty of evidence has been brought forward for the existence of a third Younger Loess. This evidence comes from areas which, for physiographical reasons, have a low precipitation to-day. Similar conditions appear to have prevailed there in the past, so that loess was deposited there, whilst in intervening areas with higher precipitation, loess deposition did not take place or was absorbed by a comparatively dense mantle of vegetation. The areas in question are (1) the Rhine Rift Valley from Basle to Mainz, and particularly its northern end, the Mainz basin, (2) Bohemia and Moravia and (3) Lower Austria. As has happened more than once in the history of a science, the first suggestion of a Third Younger Loess was based on evidence which later proved to be erroneous. This happened at the Mousterian site of Wallertheim in Rheinhessen which has proved to have an excellent stratigraphy (Schmidtgen and Wagner, 1929). The site was visited by the writer in 1950 and again in 1951, and series of samples were taken. Schmidtgen and Wagner originally suggested that a thin blackish band, which in their time appeared in the Younger Loess II (see Zeuner, *Dating the Past*, 1st and 2nd edn., Fig. 56), might constitute a weathering horizon between a Younger Loess II and a Younger Loess III. Since then, however, the soil separating the Second and Third Younger Loesses has indeed appeared in the modern extension of the pit, where the three Younger Loesses can be seen simultaneously, covered by their respective soils. The black band, of a thickness of only one to two inches, continues through the section like a line drawn with a pencil and it lies in the middle of the Younger Loess III. The section exposed at the Wallertheim site, moreover, is no longer unique. Many similar sections have since been studied and described, mainly by Schönhals (1950, 1951). This author has been able to show that the same sequence of three Younger Loesses, the third of which contains the thin black band, occurs in the Rheingau between Wiesbaden and Rüdesheim. Two noteworthy sites are the Ziegelei Klüter at Eltville and the Marienhöhe at Erbach, which were visited with Professor Franz Michels of Wiesbaden and Dr. Schönhals in 1950 and again with a party of students from the Institute of Archaeology in 1951. The tripartition of the Younger Loess is also in evidence in the southern part of the Rhine Valley at Achenheim, Alsace, but the black band is absent. The black band does, however, occur in the Limburg area, east of the Rhine and north of the Taunus Mountains, where attention was drawn to it by Hess in 1909.

What, then, is the significance of this black band which provides such an admirable guide horizon for the Younger Loess III? Hess submitted some material from Limburg for analysis and it was suggested that the band was of volcanic origin. On the other hand, it has also been suggested that it might

represent a thin soil. In favour of the latter alternative is, according to Schönhals, the arrangement of the dark particles in the band, which suggests a root-soil. Against it is its thinness (which is abnormal under ordinary conditions of soil formation) and its consistent thickness over a wide area. The matter was considered of sufficient importance from the point of view of Palaeolithic chronology to be investigated, since if the soil nature of the layer could be established, it might well have carried considerable implications. It might, for instance, have suggested a soil of Alleröd age, followed by a final period of loess deposition corresponding to the Younger Dryas time. The samples were taken by Dr. I. W. Cornwall at Wallertheim in the black layer and a few inches below and above it in the pale Younger Loess. A test for alkali-soluble organic matter showed that the quantity present was extremely small. Nevertheless, there was slightly more humic matter in the black band than below and above it. It was not enough, however, to account for the dark colour of the band. For this reason, a heavy minerals separation was carried out on all three samples and the following result was obtained:—

	Alkali-soluble organic matter	*Mineral grains of a specific gravity of over 2·75*
Loess above black band ..	0·1%	1·28%
Black band	0·2%	5·37%
Loess below black band ..	0·1%	1·28%

The specific gravity of 2·75 was chosen in order to catch as many augites, hornblendes and micas as possible. The result speaks for itself. The black band contains four times as many heavy minerals as the loess above and below. In addition a considerable quantity of the grains is magnetic, hence probably magnetite. The exact mineral composition requires examination by an expert; nevertheless the volcanic origin of the material, which was claimed by Hess for Limburg and suggested by Michels for Ziegelei Klüter, has become highly probable for the Wallertheim locality. It thus appears that the black band of the Mainz and Limburg basins is due to volcanic ash and produced by an eruption, probably in the Eifel, during the period of the Younger Loess III. Dr. J. Frechen has very kindly undertaken to make an attempt to link the ash-band with one of the known Eifel eruptions. The slightly higher content of organic matter in this layer, which has been established not only in Wallertheim but in the Rheingau also, is perhaps due to a concentration of rootlets in this layer which is richer in mineral plant foods than the pure loess. It may,

therefore, be regarded as virtually certain that the black band is not a soil representing a mild oscillation during the formation of the Younger Loess III.

It might now be suggested that the Younger Loess III as a whole is the product of the Younger Dryas time. This is improbable for climatological reasons, but admitting this possibility for the sake of the argument, the stratigraphical succession of the Niedermendig area disproves it conclusively. As has been pointed out earlier in this article, the Younger Loess of the Niedermendig area is covered by a genuine, though thin, soil corresponding to the earlier part of the Alleröd oscillation, the vegetation of which was subsequently drowned in the rain of ash and pumice of the Laacher See eruptions. Much of the flora has been collected in the nearby Brohltal and published by Kräusel and Weyland (1942). Nor has Younger Loess been found anywhere else in a position where it might be interpreted as of post-Alleröd age.

Two Younger Loesses are generally recognizable in northern France. A greater number can occasionally be distinguished on the evidence of thin solifluction horizons, but soils indicative of a temperate climate do not permit the distinction of more than two Younger Loess phases. Of these, the upper contains Gravettian and Solutrean in its upper portion. It is, therefore, the Second Younger Loess of Germany which is represented in northern France, Younger Loess III being either absent (which would not be surprising in the more oceanic climate of France) or not yet having been found.

Two Younger Loesses are well established throughout Central and South Germany, and again it is the Third that is missing, except of course in the areas mentioned.

Passing the mountain range of the Bohemian Forest, one enters Bohemia proper, whence both Schönhals (1951) and Lais (1951) have described sections with three Younger Loesses. A representative section is that of Sedlec near Prague. Still farther east in Moravia, similar conditions prevail. Several sites have been described from the neighbourhood of Brno, but from the prehistorian's point of view Dolní Věstonice is the most important, where Lais succeeded in establishing the presence of two weathering horizons in the Younger Loess. The same type of section extends into Lower Austria, where the soil between Younger Loess I and Younger Loess II has been called the Göttweiger loam or Hollabrunner humus zone, whilst that between Younger Loess II and the Younger Loess III is known as the Paudorf loam. These names were coined by Bayer and Götzinger some twenty years ago. Their stratigraphical significance has been worked out most clearly by Lais (paper written in 1944, published 1951) and Brandtner (1950).

In view of this evidence it becomes somewhat difficult to continue to doubt the tripartition of the Younger Loess. The number of sections showing it in the areas mentioned may be estimated as being of the order of a hundred.

Since three glacial phases are distinguished in the Last Glaciation and three Younger Loesses are known, it is natural to correlate these three loesses with the three morainic stages, and this implies that the third stage was weaker, for its loess has a restricted distribution, occurring in areas with relatively low precipitation of a pronouncedly continental climate. If this correlation is right, the prehistoric industries found in the loess sections must be expected to tally with those established in the morainic areas, on river terraces and in caves. This is indeed the case, though evidence cannot be presented here in detail. The Younger Loess I is everywhere characterized by the Mousterian. The Younger Loess II contains plenty of Aurignacian (in the widest sense), whilst little is known about the prehistoric assemblages belonging to the Younger Loess III. A wealth of evidence is available which proves that the Aurignacian and Gravettian industries occur in the Second Younger Loess. Linsenberg, near Mainz, has often been quoted as an example. In the western Mainz basin there is the site of Pfeddersheim which Weiler found at the base of the Younger Loess II and which he attributes to the Aurignacian *s. lat.* To be more precise, the Aurignacian *s. lat.* appears frequently so near the base of the Younger Loess II that it may have begun in the preceding interstadial. This matter, however, need not concern us here. It is noteworthy that the eastern Gravettian occurs in the same chronological position, for instance at Willendorf, where it begins in the First Interstadial and continues into the Younger Loess II, at Hundssteig near Krems in Austria, and other sites. The Aggsbachian facies occurs in the upper part of the Second Younger Loess at Hohlweg, near Krems. At Dolní Věstonice, however, the industry lies in the interstadial weathering of Last Glaciation 2/3 according to Lais. It remains to be seen whether this is a weathering horizon *in situ;* if so the material itself, including its contained industry, may have to be counted as the upper part of the Younger Loess II. If, however, it is derived material, the industry should more properly be placed in the Second Interstadial. This appears to be the latest of the Aurignacian group of industries which can be dated on geological evidence.

Returning to the Magdalenian, the evidence just outlined for the Aurignacian enables one to construct an interesting ecological picture. Evidence from the caves has shown that the early Magdalenian appeared in the latter part of the Last Glaciation 2. At this time, however, the Gravettian was still going strong in the loess areas. Except for Dolní Věstonice, there is no suggestion of the Gravettian surviving into the Second Interstadial in the area under consideration. At this time the middle Magdalenian was flourishing in the caves, but again there is no evidence of its penetration into the loess area. An apparent exception is the site of Munzingen on the Tuniberg near Freiburg in Baden, where an early Magdalenian without harpoons occurred in a loamy horizon of the loess. This site has been much discussed and doubt has been

cast upon it, mainly at a time when the loess stratigraphy was still in its initial stage. Andree (1939) has put forward a reasonable case for placing this industry in the Second Interstadial of the Last Glaciation or, in view of the corrosion of the bone artifacts, at the end of Last Glaciation 2, the corrosion being due to the subsequent interstadial weathering. In this position, Munzingen would be contemporary with the lower level of the Kesslerloch, which is typologically perfectly consistent. It is, however, worth noting, and shows how careful one has to be in one's generalizations, that Zotz (1951) argues that a rockshelter or cave was within a hundred yards of the Munzingen loess site. It is conceivable, therefore, that the "open-air station" of Munzingen was no more than an outlier of an ordinary Magdalenian cave site.

The only evidence for an open-air Magdalenian of the late type appears to be Andernach and there was reason to believe that its industry lies in the Younger Loess III, which would be contemporary with the late Magdalenian of Kesslerloch, as one would expect. In fact, if the loess were Younger Loess II, the late Magdalenian would become contemporary with the early Magdalenian elsewhere, a view that one is not inclined to cherish.

It is evident that, on the whole, the Magdalenians avoided open loess country. Instead they concentrated on tracts where caves or rockshelters were frequent and where water was available in the form of rivers or lakes. This may have something to do with fishing activities. Otherwise, the Magdalenian being essentially a culture based on the exploitation of reindeer, which is a tundra and taiga animal but shuns the steppe, it is only natural that the Magdalenians avoided the loess areas. The Aurignacians, however, made considerably more use of the horse, an animal which was frequent in the loess steppe, so it is not surprising that their sites are found comparatively frequently in the loess areas.

There is a chronological overlap between the Aurignacian *s. lat.* and the Magdalenian that may prove to be of some significance. As far east as the Polish Jura Mountains the early Magdalenian occurs. Unfortunately, it cannot be dated on geological evidence but it is unlikely to be as late as Last Glaciation 3 in view of the fact that everywhere else the early Magdalenian appears to belong to the Last Glaciation 2. If the Bohemian, Moravian and Austrian sites are correctly interpreted, the eastern Gravettian would at least be contemporary with the Magdalenian I-IV. It will be interesting to see whether Gravettian sites of Last Glaciation 3 age will be found in that area.

This picture enables one to hold one of two views regarding the final Palaeolithic of North-West Central Europe. Some workers are inclined to assign it in part to the Magdalenian; on lithic evidence an equally good case might be put forward for its derivation from the eastern Gravettian and chronologically this view is permissible also. In either case, the ecological basis of those

latest Palaeolithic industries found in areas with no caves and an increasing forest cover, would have differed from the conditions of life enjoyed by the typical Magdalenian on the one hand, and the Gravettian on the other. The question of the affinities of these newly discovered industries, therefore, still remains to be settled.

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Microlithic Industries of Mysore

By M. Seshadri

Introduction

It is a curious fact that in the whole of South Asia a true Upper Palaeolithic in the sense of the European sequence has not yet been found. Since numerous sites both of Lower Palaeolithic and microlithic industries have become known, the least that can be said is that such Upper Palaeolithic industries must be very rare.

In the late Soan of north-west India (now Pakistan) a flake element becomes rather prominent, so that it is possible that the hand-axe industries were followed by a period of flake industries based on the Levalloisian technique. But sites with pure and typical industries are still wanting. On the other hand, if one approaches the problem from the post-Palaeolithic side, the oldest industry found by Subba Rao (1948) at Sanganakallu, Bellary District, just north of the Mysore border, contains a Levalloisian element. Its patinated flakes of trap and sandstone, of which about 400 have been found, are, at least in part, made from cores prepared in the Levalloisian fashion. This is specially evident in the case of the short round flakes whose upper surfaces clearly show a preparation by flaking from the periphery of the core prior to the taking off of the flake. Similarly long flakes were struck from cores from which other long flakes had previously been taken off in the same direction. Such flakes have in many places been produced by a Levalloisian technique, such as the so-called blade-flakes, for instance, of Markkleeberg (Central Germany), of the Somme (northern France), in the Mount Carmel caves (Palestine) and elsewhere. On the other hand, blade-flakes are easily produced from cylindrical or conical cores. This applies clearly to the long trap and sandstone flakes from Sanganakallu, since there are specimens with platform angles indicating a conical core, and with single ribs on the back. The method of making these artifacts, therefore, was the same as that used for the microlithic blades of the same locality. They are no more than a large facies of the microlithic blades. Subba Rao expressly states that microliths were actually found in association with the flakes under discussion.

A similar occurrence of blade-flakes in association with microlithic artifacts is observed also in a collection of implements from Hyderabad made by von Fürer Haimendorf. It is composed of surface finds, and is housed at the Institute of Archaeology, London. It contains large numbers of rough fluted cores which may be regarded as giant forms of the microlithic cores. With

them occur numerous flakes comparable with those from Sanganakallu, and also many microliths.

This evidence is admittedly scanty and unsatisfactory in so far as the Hyderabad finds do not come from a studied section. At Sanganakallu, however, the section has been studied with care, and the industry in question is clearly older than the pure microlithic. One is then left with the impression that the microlithic industries of South India can be derived from a hypothetical Levalloisian flake industry which preceded them.

In this respect South India would not stand alone since, in North Africa, the Aterian, a direct descendant of the Levalloisian, passes into microlithic industries such as the Oranian (Ibero-Maurusian), in the opinion of Professor Vaufrey (1933). Similar is the case in East Africa, where the Levalloisian Stillbay, in turn, passes into the Magosian, and Wilton B (Leakey, 1936).

The only element in the South Indian stone age which might conceivably be regarded as Upper Palaeolithic is the "Industry III" of the series of Cammiade and Burkitt (1930) from the Nandikanama Pass and other localities. It is characterized by the presence of "slender blades with blunted backs, a few burins, planing tools and end-scrapers." It must, however, be noted that these elements occur in the microlithic industries also. Crescents and points figured by Cammiade and Burkitt on their Plates V and VI are particularly striking. So far as evidence goes, there is no need to assume the presence of an independent Upper Palaeolithic in South India.

Apart from stray discoveries, regular assemblages of microlithic implements have been produced at the following sites in Mysore:—

(1) Jalahalli, about ten miles north-west of Bangalore. Two wedge-shaped granite hills contain in places intrusive veins of milky quartz and rock-crystal which provided raw-material. From both Todd (1948) collected series of microlithic implements, which are now in the British Museum (Bloomsbury).

(2) Hindustan Aircraft Factory site, Bangalore.

(3) Bangalore–Sarjapur Road site, a few miles from Bangalore. A large collection of implements and flakes was made by Col. Gordon from (2) and (3) and very kindly presented to the Institute.

(4) Brahmagiri is a granite outcrop rising some 600 feet above the plain in the northern extremity of Mysore State. Excavations on this town-site in 1940, 1942 and 1947 (Wheeler, 1947) revealed a culture associated with microlithic implements.

The Jalahalli industry is almost exclusively composed of implements made from quartz and rock-crystal, the majority being smaller than 2 cm. In spite of their small size, the implements are remarkably varied in type, and the

proportion of worked specimens to unretouched flakes is unusually high. About 75 per cent are retouched flakes.

Cores. The cores vary from 1 cm. to 3 cm. in length. Pointed cores form the majority, though cylindrical and conical flat-based cores and chisel-ended cores are present also. The pointed and chisel-ended cores are, of course, nothing else but finished specimens derived from conical flat-based originals, whilst the rare cylindrical cores represent a different type. The presence of thin and long blades shows that fluting, though difficult on quartz, was practised with considerable success. The presence of a few larger flakes, however, suggests the existence of large cores at Jalahalli. None of these are included in Todd's collection. Perhaps they were overlooked, while collecting.

Flakes. Of the numerous flakes, hardly any show marks of utilization. The largest, which is thick and heavy, and has a prominent bulb of percussion, is $5\frac{1}{2}$ cm. long.

Points. The most characteristic tool of the series is an asymmetrical point with a wholly blunted back. Of the total number of thirty-nine, twenty-five are obliquely blunted on the left, fourteen on the right. They resemble the shouldered points of Europe but are much simpler, and the "shoulder" used for hafting is usually due to the shape of the flake used. Functionally, however, these are arrowheads and they could have been hafted in the same way as the true "shoulder point." There is also a round-based point in the assemblage. A small curved point of rock-crystal may be compared to the "Frensham" point of Rankine (1951). Some points are perhaps better described as drills. One of them, made out of quartz, has been finely blunted on both sides.

Triangles. There are two isosceles and five scalenes in the collection. On most triangles the retouch is clearly seen since they are made out of rock-crystal.

Lunates. The lunates constitute a conspicuous group of the assemblage. They form 38·7 per cent and 32·4 per cent of the artifacts from the quarry hill and the surface respectively. Since most of the lunates are asymmetrical, it is possible that some were used as arrowheads or arrowbarbs.

Petits tranchets. An interesting feature of the Jalahalli microlithic industry is the presence of petits tranchets (10). This is particularly interesting in view of the fact that they are very rare on Indian sites. One single specimen was published by Bruce Foote (1916, Plate 14, No. 43) from the "Teri" site of Sawyerpuram in the Tinnevelly District.

Burins. Though the burin is one of the most characteristic types of the Upper Palaeolithic of Europe, it is, of course, common also in mesolithic assemblages.

The Jalahalli assemblage comprises five burins, three of quartz and two

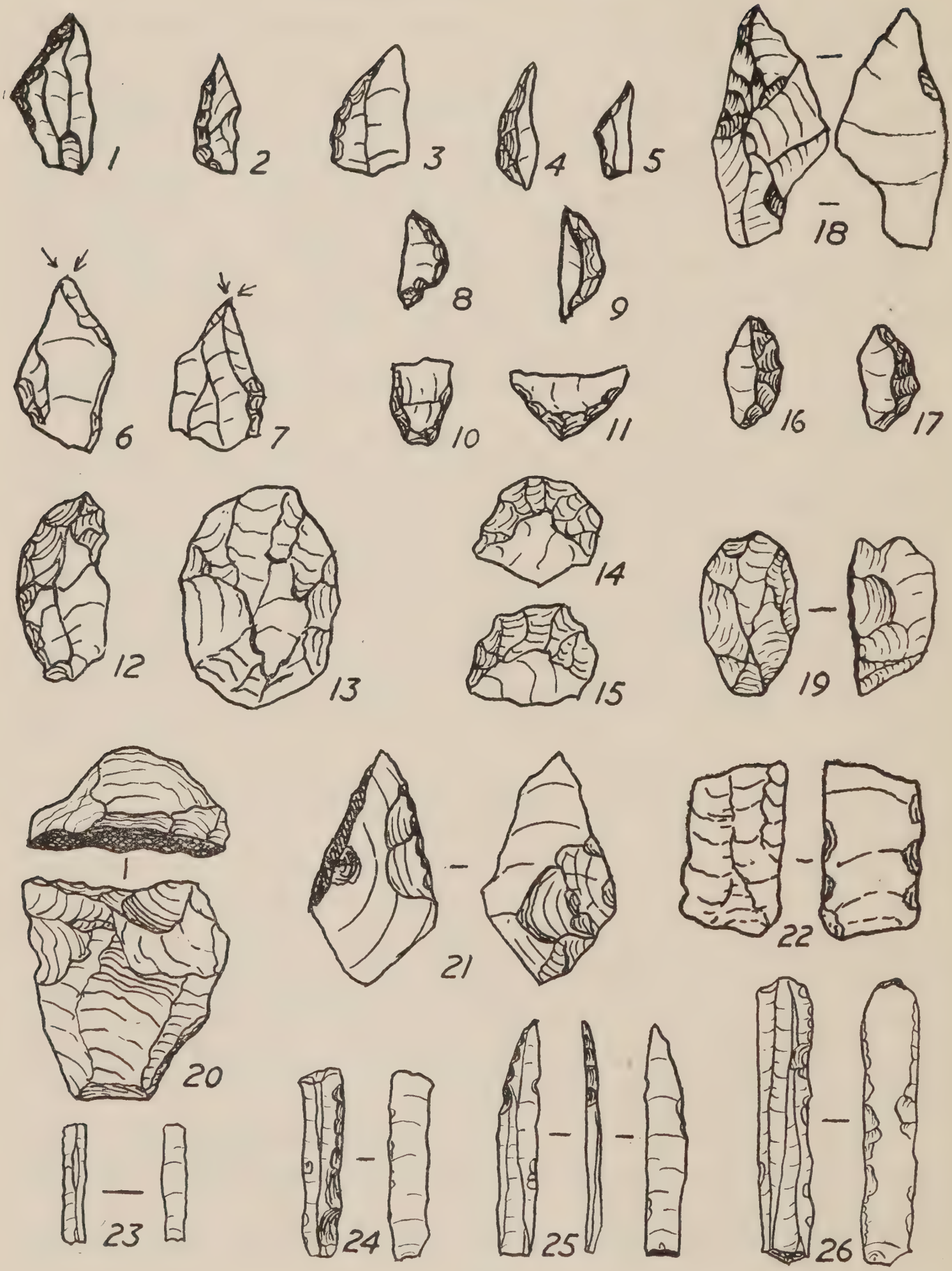
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FIG. 1.

1–15 Jalahalli:
1–5, points,
6–7, burins,
8–9, lunates,
10–11, petits tranchets,
12, side-scraper,
13, round scraper,
14 and 15, thumb-nail scrapers.

16–17 Hindustan Aircraft site:
two lunates.

18–19 Bangalore–Sarjapur Road site:
18, "shouldered point,"
19, steep scraper.

20–22 Brahmagiri "Pre-I" industry:
20, scraper made from core,
21, point,
22, crude parallel-sided blade.

23–26 Brahmagiri IA, IB industry:
23, small microlithic blade,
24, backed blade,
25, "Gravettian" point,
26, used blade.

[Scale: Natural size.]

of rock-crystal. The rock-crystal specimens are small and measure 13 mm. and 10 mm. respectively. It must be noted that quartz burins are not so obvious as those of flint or agate owing to the less regular surfaces of the flake scars. The quartz burins which are larger conform to the "A" type (*bec-de-flûte*), the rock-crystal specimens belong to the "J" type and "L" type of Noone (1934) respectively.

Scrapers. In addition to end-scrapers, side-scrapers which are longer than broad are a speciality. Three of these side-scrapers have curved edges with fine retouch.

Hindustan Aircraft Site. The number of artifacts from the Hindustan Aircraft Factory site is very small. Out of a total of seventeen, twelve are lunates and the rest points. Apart from finished implements, there exist a few cores and flakes.

Bangalore–Sarjapur Road. The site near the Bangalore-Sarjapur road appears to be a good manufacturing site. The collection which was made by Col. Gordon consists of cores and a large number of primary flakes. Among the finished artifacts there is a chert arrowhead which resembles a shouldered point, (1). The tang is due to the removal of a single fragment of chert, however, and not to detailed retouch. Some of the points are thick; others have been blunted obliquely on the left all along the edge. Their retouch is very steep.

Of the fourteen scrapers, six are end-scrapers. Some good examples of end-scrapers or blades are included among the remainder. Three steep-edged scrapers which may be small editions of the keel-scraper deserve special mention. The rest are side-scrapers or flakes with steep retouch along a curved edge. Some are longer than broad, but others approach the thumb-nail type. These side-scrapers are characteristic of the Bangalore industries.

Only three lunates and an irregular triangle are present. In this respect the industry differs from Jalahalli.

Nevertheless, the Sarjapur road industry, as well as the one from the Hindustan Aircraft Site, cannot be easily distinguished from the Jalahalli industry. Points, lunates and triangles are common to all these industries and on typological grounds it would be difficult to separate them.

What distinguishes them is the quantity of lunates, which make up one-third of the Jalahalli collection, two-thirds of the Hindustan Aircraft collection, and only about one-tenth at the Sarjapur road. One might regard this as significant. It is possible, however, that accidents of collecting account for this, and the writer prefers to regard these industries as one complex until further collecting has confirmed the differences in the frequency of lunates.

Brahmagiri "Pre-I." Apart from the town-site industry to be discussed presently, Brahmagiri has yielded a group of microliths of chert, jasper and opal found on the surface. Some of them have secondary working and show signs of use. Among them are two arrowheads and a probable awl of opal. It is difficult to fit this group into the industry which occurs in the excavation at Brahmagiri. Typologically, it is comparable to the microlithic phase I of Sanganakallu, near Bellary. It appears, therefore, that this group of surface finds at Brahmagiri may have preceded the IA phase of the polished stone axe culture of the Brahmagiri excavation. For the sake of easy reference this group has been called "Pre-I."

Brahmagiri IA, IB. The second group is characterized by slender, long blades totally different from the industries described on the preceding pages. All the microliths from the excavations belong to it. Seven types of artifacts were already distinguished by Wheeler (1947) on the basis of shape. There are, however, few retouched implements in the assemblage, so that it is difficult to obtain a functional classification. Sixty-four specimens are primary parallel-sided blades. They are not blunted. Use-marks occur very frequently on them. They were presumably used as knife-blades.

A group of retouched implements from Brahmagiri is that of the blunted-back blades. Six such specimens came from excavations. Three more have the working edge slightly serrated, probably owing to use. One good specimen of this type was found on the surface.

A few of the blades have been converted into points by a gradual oblique blunting. They resemble Gravettian points from the Upper Palaeolithic of Europe, though this does not, of course, imply any real affinity. One good example comes from the surface (Fig. 1, No. 25).

No true lunates have yet been found at Brahmagiri and, if they occurred, must have been very rare. Only one specimen (Wheeler, 1947, Fig. 34, No. 21) may be described as a crescentic blade.

Only Nos. 31 and 32 (Wheeler, 1947, XXXIV, Fig. 34) have been classified as "gravers" (burins). They prove, however, to be waste blades which resemble burins by chance. Thus it appears that burins are entirely absent from the Brahmagiri microlithic collections.

This is the characteristic feature of the Brahmagiri microlithic industry. If one accepts the industry as an ordinary microlithic one, one would expect to find burins, as well as points, lunates and triangles. The vast majority of artifacts therefore consist of simple blades with little and sometimes no secondary working. On the whole, Brahmagiri suffers from a dearth of specialized implements; it is a very simple non-geometric industry based on small parallel-sided blades.

The differences between the Jalahalli and Brahmagiri IA-IB industries are striking. Types and techniques are quite dissimilar. The Jalahalli industry has steep retouch while that of Brahmagiri has nibbled retouch. The blunted-back and serrated blades of Brahmagiri IA and IB are not to be found at Jalahalli. The large number of parallel-sided blades two inches long are reminiscent of the long, slender blades of Harappa and Mohenjo-daro. Brahmagiri represents a village culture in which arrowheads, lunates and other parts of the hunting equipment are absent, whilst the long knife-blade, presumably a good and cheap kitchen tool, remains as almost the only piece of equipment made of unpolished stone. These microlithic blades were in all likelihood supplemented by copper tools. A copper chisel was actually found *in situ* in the microlithic layer of the IB culture (Wheeler, 1947). Previously Dr. Krishna had found a tool made of copper in the level of the stone axe culture (1942). A few other metal objects are known in addition to these.

The Jalahalli microlithic industry, however, with its preponderance of lunates, points and arrow barbs, is ideally suited to a hunting economy and environment.

To sum up, Mysore has yielded three types of microlithic industries:

(1) Jalahalli hunting type,

(2) Brahmagiri Pre-I type,

(3) Brahmagiri IA and IB urban or village type.

The age of the Mysore microlithic industries now requires to be discussed.

At the very outset one is confronted with the fact that in many places in India the microliths do not seem to represent a "mesolithic" culture, as they would if found in Europe. Some are clearly associated with the neolithic complex. Others may have been protoneolithic, as De Terra and Paterson (1939, p. 320) suggest. Microliths from Pachmarhi, Hoshangabad and Singanpur in Central India are late survivals and are not likely to antedate 500 B.C. at

the earliest (Gordon, 1938, p. 23). Cammiade (1924, p. 101) points out instances where microliths have been found in association with protohistoric urn-burials.

Todd, on the other hand, believed that the microliths from Khandivli, judging from typology and patination, were much older than those of the Central Provinces. These finds are outside the scope of this paper, but it is important to realize that some true "mesolithic" phase may still be established in India. On the Sawyerpuram microliths, Foote's (1916) opinion was that they lay embedded in the fossil sand dunes (Teris) and were stained red owing to their long contact with the ferruginous soil. Aiyappan (1942, p. 146), who re-investigated the site, however, was inclined to believe that the makers of microliths had deserted the site before the advent of the neolithic technique, and were thus of some considerable antiquity. Moreover, Zeuner (1952) has pointed out that the microlithic industry of the lower level at Langhnaj, Gujarat, is a hunting industry apparently of pre-pottery age.

Thus the microliths of India appear to cover a long range of time. Their beginnings, indeed, may go back to a period which may one day prove to be placeable in a true mesolithic, but undoubtedly survived well into the historic period, on the evidence which is available at the present moment.

In considering the age of the Mysore microliths in terms of this background, the Jalahalli and the Brahmagiri industries must be taken separately.

At Brahmagiri, the microlithic industry is associated, in the main, with polished stone axes of the IB and IA phases. They practically disappear above the layers of the megalithic culture which may be safely dated to *c.* 300 B.C. On carefully considered stratigraphical evidence the polished stone axe culture of Brahmagiri has been assigned to *c.* 1000 B.C. (Wheeler, 1947). The microlithic industry of Brahmagiri, therefore, ranges in point of time between *c.* 1000 B.C. and *c.* 300 B.C.

The Jalahalli artifacts were found resting on the granite or on lateritic pellets and below a black soil up to five feet thick containing Iron Age pottery in a distinct horizon. (Todd, 1948, p. 27). The occurrence of the tools in this layer just above the bedrock and below a soil, appears to indicate a relatively early age for this industry.

Todd believed that owing to the absence of heavier types of tools, the Jalahalli industry belonged to the beginning of the latest microlithic phase, but the occurrence of a large quartz flake with bulb of percussion suggests the possibility that roughly made heavy tools were actually present in the assemblage, but that their presence had escaped the notice of the collectors who were concentrating on finding microliths.

Furthermore, the presence of the burins has often been regarded as indicating a mesolithic (or even Upper Palaeolithic) culture. Blade-and-burin industries have been reported from three regions in India:—

(1) In and round Bombay (Todd, 1939, J.R.A.I., LXIX),

(2) Madras Province (Cammiade and Burkitt, 1930),

(3) Jalahalli, Mysore State.

On this evidence it would be possible to maintain that a mesolithic industry existed in India were there not indications that the characteristics commonly given for the mesolithic continued into later periods in certain regions.

Instances are not wanting for the late persistence of the burins. For example, a series of burins including angle and *bec-de-flûte* types, occurs in the neolithic Dhobian* industry of Palestine. The Wilton A and B industries of South and East Africa have striking resemblances to Jalahalli. The similarities are:—

(1) presence of large numbers of lunates,

(2) large numbers of thumb-nail scrapers,

(3) points, and

(4) burins.

One difference, however, has to be noted. No pottery has been found associated with the Jalahalli artifacts. The Magosian and Wilton industries are both associated with pottery and ostrich beads.

The age of Jalahalli, therefore, cannot be determined conclusively on typological grounds. Geological evidence, however, seems to assign a greater antiquity to Jalahalli than to Brahmagiri IA-IB ,for the implementiferous horizon of Jalahalli is covered by a black formation up to five feet thick and comprising a level with "Iron Age" pottery. It would appear, therefore, that three microlithic facies can be tentatively distinguished in Mysore State:—

(1) Jalahalli,

(2) Brahmagiri Pre-I,

(3) Brahmagiri IA-IB.

Typologically the three phases are different, too, though the material from (2) is scanty. Industry (3) is plainly of the village or peasant type and (1) belongs to the "hunting" group. But one must not regard this ecological difference as indicating evolution. It so happens that in Mysore State the hunting site of Jalahalli is older than the settlement of Brahmagiri. But elsewhere the hunting-type microlithic is known to have continued well into the metal ages. Hunting and village microlithic complexes have existed in India side by side from the time of the Indus Valley civilization into the Iron Age.

* Excavations at Wadi Dhobai, 1937–38 and the Dhobian industry: *Journal of the Palestine Oriental Society*, Vol. XVIII (1938).

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Notes on a Tentative Correlation of Southern African Stone Age Cultures

By Roger Summers

Although Clark has published a comprehensive correlation table covering cultures and climates from the Cape to the Equator[9] it was felt during Institute lectures on the Southern African Stone Age that a somewhat more restricted table would be useful both to introduce students to the nomenclature which has been evolved for that area and also to draw into perspective the various cultures and variations to which reference has been made in the literature—particularly Leakey's *Stone Age Africa*. The publication of the results of Davies' recent work has permitted the inclusion of Natal cultures in the general scheme.

The area under consideration covers most of Africa south of 10° S but Mozambique (Portuguese East Africa) and South West Africa have been omitted since prehistoric studies there lag far behind those elsewhere.

Nomenclature

The use of the comparative in the first and third major divisions of the Stone Age should be noted as these were originally adopted in case some intermediate stage should be discovered later. This was subsequently recognized and the term Middle Stone Age given to it.

Very roughly E.S.A. corresponds to the Lower Palaeolithic, M.S.A. to Upper Palaeolithic and L.S.A. to Mesolithic in Europe.

In view of the fact that Southern African prehistoric studies are still in a pioneer stage it has been necessary to classify some cultures on typological grounds alone in the absence of known stratigraphy, in such cases *Early, Middle* and *Late* are used instead of *Lower, Middle* and *Upper*, which are retained only where stratigraphical relationships exist.

There are some inconsistencies in nomenclature in the table: for instance, the hand-axe cultures are named in some areas *Stellenbosch* and in others *Chelles-Acheul*; the latter was adopted at the Pan-African Congress on Prehistory in 1947 but the former is included here since that is the name given in the literature.

Earlier Stone Age

Pre-Chelles-Acheul industries resemble Oldowan and Kafuan of East Africa but there are also somewhat different chipping techniques.[5]

	Cape Province	Natal	Orange Free State
LATER STONE AGE	Cape Wilton Smithfield C[2] Wilton *s.s.* ,, B ,, A	Smithfield N[2]	Free State Wilton
MIDDLE STONE AGE	Howieson's Poort[1]		Final South African Upper ,, ,, Middle ,, ,, Lower ,, ,,
	Still Bay[2] *s.s.* Craddock Alexanders-fontein Glen Grey	Natal M.S.A.	Vlakkraal[6] Hagenstad
EARLIER STONE AGE	Fauresmith[3]	Natal Sangoan[4]	Late Middle Early
	Cape Stellenbosch[3]	Natal Chelles-Acheul V[5] IV III II I	Vaal
		Pre-Chelles-Acheul[5]	

OUTHERN AFRICAN STONE AGE CULTURES

Transvaal	Southern Rhodesia[8]	Northern Rhodesia[9]	
	Iron Age Cultures		
nithfield C[2]	Southern Rhodesian Wilton	Upper N.R. Wilton / Lower N.R. Wilton — Nachikufan (3 stages)	LATER STONE AGE
,, B			
,, A			
agosian (Proto-Wilton)	Rhodesian Magosian		MIDDLE STONE AGE
,,			
,,			
,,			
al Pietersburg	Rhodesian Still Bay		
te ,,			
ddle ,,			
rly ,,	Rhodesian Proto-Still Bay		
	Desert Conditions		
uresmith[7]	Rhodesian Sangoan — Luangwa variant in East; Zambezi variant in West		EARLIER STONE AGE
,,			
,,			
lenbosch V[7]	Rhodesian Chelles-Acheul	Late Rhod. Acheulian	
IV		Middle ,, ,,	
III		Hope Fountain	
II		Early Rhod. Acheulian	
I		Rhod. Chellean	
Break of unknown duration			
Pre-Chelles-Acheul[7]			

The break between *Pre-Chelles-Acheul* and *Chelles-Acheul* appears to have been one of long duration during which rivers cut down about half the depth from the highest river terraces to the present stream beds.(7)

The Chelles-Acheul proper consists of hand-axe industries.

The Hope Fountain was the first Southern Rhodesian culture recognized but in the absence of stratigraphy it was difficult to place.(8) Clark's *Hope Fountain* differs in some respects from that at the type site.

The *Fauresmith* appears to be a direct development of the Stellenbosch whereas the *Sangoan* seems to have intruded from Central Africa where closely similar cultures exist.(9)

Recent (unpublished) work has shown that very close similarities exist between Clark's *Zambezi variant* of the *Rhodesian Sangoan* and the Southern Rhodesian *Bembesi Culture* of Jones. The possibility of duality in the Sangoan in Southern Rhodesia is being examined.

The *Natal Sangoan* (previously *Tugela Culture*) appears to be closely related to the Rhodesian Sangoan cultures.

Middle Stone Age

The South African cultures enclosed in the "box" form the *Middle Stone Age Complex* and are local variations of an advanced faceted platform (Levallois) technique. Raw materials appear to play an important part in dictating the variations in tool forms and types. Chronologically the relationship between the various cultures is unknown although the *Still Bay sensu stricto* would appear to have a long life whereas some of the others seem to be restricted both in time and space. The *Pietersburg* rests directly above the *late Fauresmith* and no cultural break can be detected.

The *Rhodesian Still Bay* was originally named by Armstrong the *Bambata Culture.*

The *Magosian* contains a proportion of small tools made by the same technique as the larger ones, however it seems to be a direct development from the Still Bay and Pietersburg.

Later Stone Age

In the Rhodesias some break between Magosian and Wilton seems to appear in places; the *Final S.A. Magosian* is, however, indistinguishable from *Wilton.*

The existence of two L.S.A. cultures is of considerable interest: they are totally different, Wilton being almost entirely microlithic whereas Smithfield and the allied Nachikufan are macrolithic. The difference does not seem to be related to raw materials but may be due to the intrusion of a foreign culture

since Wilton flaking and core technique differs markedly from its contemporary Smithfield and its predecessor Magosian.

Correlation with East Africa

The present writer feels that correlation with East Africa involves so many unknown factors that it is unwise to attempt it until more is known of Tanganyika's prehistory.

Assuming, however, that Wet Phases in Southern Africa correspond to Pluvials in East Africa (although the two areas are now in different climatic zones), it would seem that the Pre-Chelles-Acheul falls before the Kageran; that Stellenbosch II is about the Kamasian; that the Early Middle Stone Age corresponds to the Gamblian; that the Upper Magosian is about the Makalian and that the Nakuran wet phase occurred during the earlier stages of the Wilton and Nachikufan cultures. It must, however, be realized that these correlations are open to a considerable degree of doubt.

Acknowledgement

I am greatly indebted to the Director of the Archaeological Survey of South Africa for information relating to South African cultures.

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Archaeology and Agricultural Botany

By H. Helbaek

The co-operation of archaeology and agricultural botany is approaching its centenary. In the middle fifties of last century Adolphe de Candolle[1] launched the ideas which led to the systematic study of the racial history of cultivated plants, and about the same time the great cereal deposits were discovered in the Swiss lake dwelling sites. In publishing his reports on these, Oswald Heer[2] established the connection between the two sciences of botany and archaeology, a connection which has proved extremely profitable to both.

To-day many sciences contribute to our growing knowledge of the history of cultivated plants. Interpreting the earliest written documents linguists were able to point out when and where certain plants were grown from the dawn of literacy, and also to find evidence of cultural relations on the basis of related plant names in different languages. Plant geography maps out the range of distribution of the possible wild progenitors, thus delimiting the areas in which alone cultivation could have begun. Geology and climatology may modify this picture by disclosing ecological changes in the relevant areas in the course of time. Above all, genetics, by observing morphological changes in plants caused by mutation and hybridization, is able to outline the possibilities of evolution in the species, at the same time narrowing the field of possible ancestors.

All these sciences, however, suffer from one common disadvantage. They cannot lay hands upon the actual plants of antiquity. This is where archaeology comes in. Archaeology can recover the plants themselves and put a date to them—at least a relative date. The botanical archaeologist is able to define morphologically the features of the plants and to depict them exactly as they looked millennia ago. Whereas the conclusions of biology and linguistics will always be open to discussion—as is apparent in the literature—because they are unable to produce concrete proof, archaeology will at all times have the last word in the discussion.

The following paragraphs give a brief survey of some of the plants to the cultural history of which archaeology has contributed, adding one or two items of news derived from my own most recent investigations.* Instead of giving a sketchy description of all the plants, I propose to confine myself to a somewhat fuller discussion of those which were the principal economic basis of the Neolithic and later prehistoric cultures of the Near East and Europe.

* Statements thus marked refer to still unpublished investigations by the present writer.

Wheat

Before discussing the origin of the wheats it is necessary to recapitulate their taxonomy. Genetically the cultivated species of *Triticum*, the wheat genus, are classified in three groups; namely, the diploid group,[3] consisting of Einkorn (Small Spelt) only; the tetraploid group, including Emmer, Macaroni

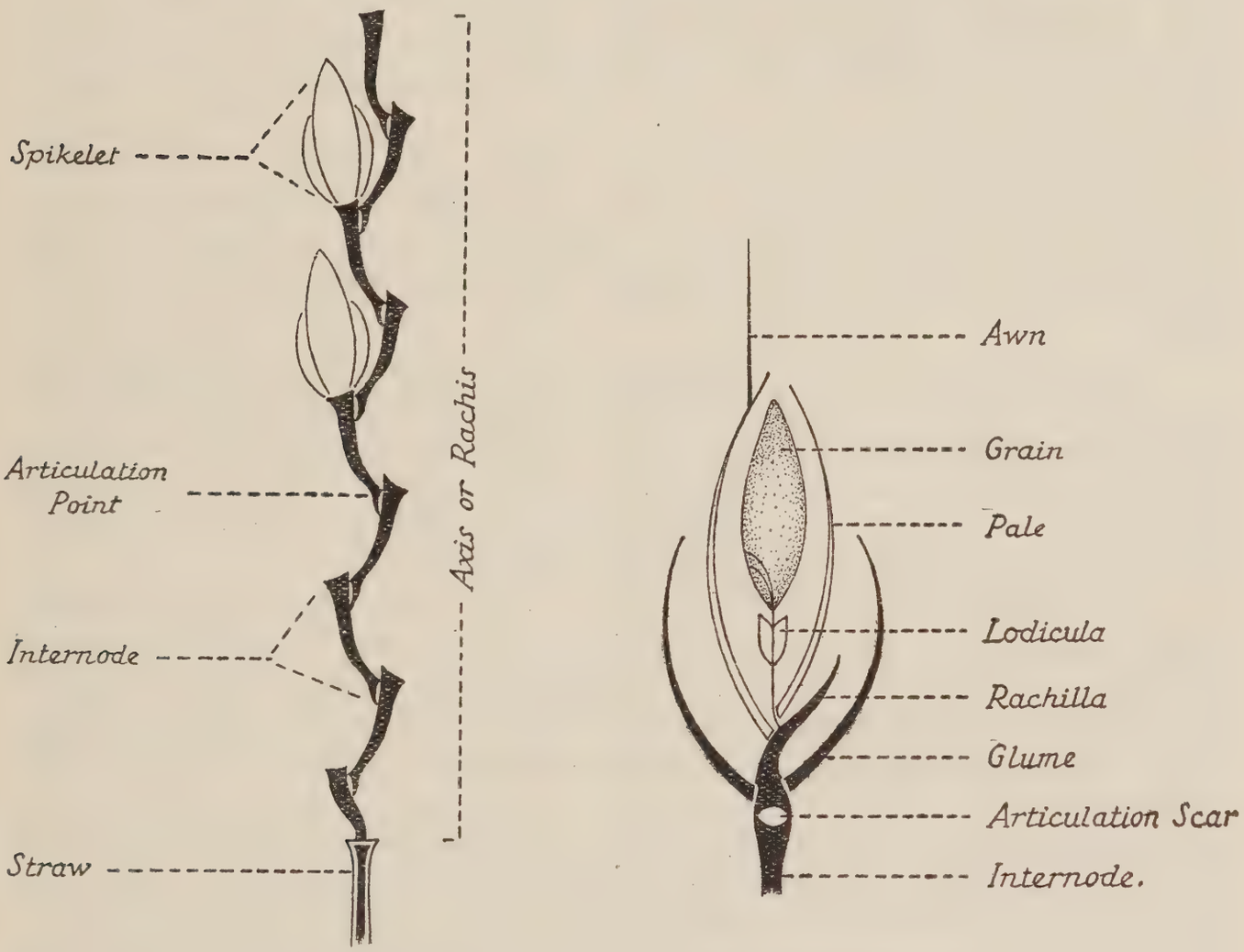


Fig. 1. Diagram to explain technical terms used

wheat, Rivet wheat and several others; and finally the hexaploid group, comprising Bread wheat, Club wheat and Spelt. (Plate I.)

However, irrespective of genetical views, Einkorn, Emmer and Spelt are often placed together on purely morphological grounds in a group called the Glume wheats. As opposed to all other species, these three have retained some of the characters typical of the wild species, such as a rather fragile axis (rachis) and stiff, close-fitting glumes which do not release the grains when threshed. In all other wheats the grains are loose within the spikelet at maturity and are

easily detached and separated from the chaff. These are called the Naked wheats.[4]

Consequently, it very often happens in carbonized grain and in impressions in clay that the glumes of the Glume wheats occur associated with the grains, thus ensuring a positive identification even when the grains are puffed and misshapen. In deposits of Naked wheat no glumes or internodes will be found, and, as the grains of these species are very much like each other in the carbonized state, it is only occasionally possible to identify with complete confidence the individual species of this group as for instance in the case of Club or Bread wheat.

Judging by archaeological finds made up to now, wheat and barley were the first cereals to be cultivated. They occur together in practically all early grain deposits in Egypt, Mesopotamia and Europe. So far we have never been able to point out a Neolithic community exclusively based upon one of them alone.

The wheat which occurs associated with the artifacts of early peasantry from Mesopotamia and Egypt to Britain and Scandinavia is principally Emmer, *T. dicoccum*. The great wheat deposits of Egypt dating from the Neolithic to the time of the Roman Empire consist of this species almost exclusively, and everywhere it appears as a highly developed cereal, even in the Neolithic, quite different morphologically from any wild species.

The Russian plant geographer, Vavilov,[5] whose extensive plant collections in Asia and eastern Africa have transformed the basis of modern plant breeding research, propounded the theory that the place in which a cultivated plant occurs in the greatest diversity should be considered the place of origin of the plant. This concept is referred to as the multiplicity-centre or the gene-centre hypothesis.

To-day the gene-centre of Emmer is Abyssinia, and this circumstance and the early occurrence of Emmer in Egypt as a highly important food plant brought about the belief that the species was first cultivated in Abyssinia. In the Neolithic it was supposed to have spread from Upper Egypt partly across the Red Sea to Yemen, partly along the Nile and the eastern Mediterranean to Syria, where it would have branched to Mesopotamia in the east on the one hand, and to Asia Minor in the north-west and further on to Europe on the other. As the tetraploid wild wheat, *Triticum dicoccoides*, was not discovered in Abyssinia, Vavilov simply rejected it as the progenitor of the cultivated species.

At the present time, however, *T. dicoccoides* is generally acknowledged as the progenitor, and thus we must look for the place of original cultivation within its distributional area, which extends from Syria and Palestine to Iraq and Persia. Schiemann[6] has suggested as most probable the mountainous

regions of Transcaucasia and Persia. As a matter of fact, this is just the area in which the first traces of initial cultivation have been established archaeologically. It is, however, quite likely that domestication will prove to have been started in several places within the whole distributional range.

When considering the fact that all Neolithic Emmer so far described or recorded consists of a uniform and highly specialized type, we realize that it cannot be the crop of the first few generations of plants, perhaps not even of the first hundred generations. Some time must have elapsed since the wild wheat was first domesticated. When encountering a really early stage of cultivation we should expect to find cereals of varied and wild types, and when discovering cereals approximating to wild types in prehistoric sites we should be entitled to interpret such evidence as indicating cereal cultivation in its initial stages. Quite recently this has actually happened.

In a typologically very early Neolithic site in the foothills of north-eastern Iraq, Jarmo,[7] recently excavated by the Oriental Institute of the University of Chicago under the direction of Robert Braidwood, a series of impressions were discovered in clay lumps, revealing spikelets of a wheat (Plate II, 1–3) very near to the present wild *T. dicoccoides* and much coarser than the oldest Emmer known so far.* Carbonized grains from the same layers very closely resemble in size and appearance the recent wild *T. dicoccoides*, and they are quite different from Neolithic Emmer grains found at other localities (Plate III, 1).

There seems to be no reason to doubt that in Jarmo we are faced with the earliest stage of plant breeding hitherto discovered, an assumption which is strongly supported by the primitive appearance of the cultural remains as a whole. However, that even Jarmo does not represent the very first steps in the agricultural economy is suggested by the fact that its wheat spikelets seem to belong to a crop of a conspicuously mixed character, some of them being large and coarse, others more delicate and resembling the typical cultivated Emmer. Evidently, human selection had not been carried very far, and one gets the impression that the early steps in the morphological change caused by cultivation were accomplished comparatively quickly. It is probable that the mutation rate was accelerated by forcing the plants to grow below the lower limits of the natural habitat of the wild plants, i.e., in altitudes and localities more suitable for tilling the soil and utilizing the rainfall than the steep slopes where *T. dicoccoides* usually grows wild.

Supported by theoretical conclusions as well as by this practical evidence, we may now take it that Emmer was brought to the west from northern Mesopotamia, and possibly other places within the distributional range of *T. dicoccoides*, by the great Neolithic migration. At the eastern end of the Mediterranean the flow divided, southwards to Egypt and north-westwards

to Asia Minor and Europe. Emmer occurs abundantly in the Neolithic deposits of Egypt, and it is found in early strata in Palestine, Syria and Asia Minor. All along the Danube the Neolithic peasants cultivated this cereal. The most spectacular European discovery of Neolithic Emmer was made a hundred years ago in the Swiss lake dwellings.[2] Only after its identification here was it acknowledged as a European prehistoric cereal, but since then it has been realized that Emmer had spread to all parts of the Continent so far investigated already with the earliest peasants and probably everywhere as the principal food plant.[6][8] In no tolerably large Neolithic find does the supremacy of Emmer seem to be in any way contested. The plant throve well in the Sub-boreal climate even of north-western Europe, a region where it would hardly produce a profitable crop to-day.

The first traces of agriculture in Scandinavia and the deposits of the Windmill Hill and Peterborough phases in England include remains of Emmer. It spread to Scotland and Ireland with the first peasants, too. During the British Bronze Age cultivation of Emmer seems to have been more or less restricted to England, and even there it falls far behind barley in importance. Evidently the Celtic invasions of the Early Iron Age brought new impulses from the Continent, and wheat enjoyed a come-back which lasted throughout the Roman period. This time, however, new varieties were included in the crop, namely, Spelt and Club wheat. Indeed Club wheat has been found along with Emmer already in the Neolithic, but only sporadically. The latest evidence of Emmer in Britain comes from the Early Christian period, at Barhapple Loch in Wigtown.[9]

At the time of the Roman Empire, Emmer was replaced in Egypt by Naked wheats, in Mesopotamia perhaps even earlier. In Europe it seems to have petered out in most places during the Late Bronze Age, surviving only in isolated areas, as for instance in Gottland[10] and Bornholm in the Baltic* and in mountainous parts of central Europe. In Switzerland it is still being cultivated to a small extent. In the Balkans, Russia, Transcaucasia and Abyssinia, too, it has survived. Its cultivation in India is at present considered a fairly recent phenomenon, as no old Indian names are known for the plant. This area would be an extension of the Upper Egypt–Yemen line. However, reports on grain from the early Indus valley cultures may still modify our views on this point.

Cytologically Emmer is grouped together with a number of Naked wheats, all of them tetraploid. It is believed that these Naked wheats were derived from Emmer by mutation or hybridization among different varieties. They display a great diversity in morphological and physiological features, approaching Emmer on the one hand and the Bread wheat group on the other. Even though archaeology has not yet contributed anything decisive to the history of the

tetraploid Naked wheats, they deserve mention in this connection, since two varieties have already been reported from archaeological finds. It should be pointed out, however, that these identifications cannot be considered trustworthy.

According to the theory of their phylogeny, the tetraploid Naked wheats would have emerged somewhere in the area of Emmer, and the situation of their present gene-centre suggests that this would have happened in the region between the eastern Mediterranean and Transcaucasia. In this area a great number of varieties are even to-day cultivated. Only one member of this group, Macaroni wheat (*T. durum*), has gained a position of importance in world economy. It occupies the steppe regions all over the world, where Bread wheat cannot thrive. Another species is Rivet wheat (*T. turgidum*), which is grown in western and Mediterranean Europe and as far as Transcaucasia. These two are said to occur in prehistoric sites, but no good material evidence has been offered to substantiate the claim.

A further development of Emmer is reflected in the Bread wheat group of hexaploid Naked wheats. These varieties, comprising the dense-eared Club wheat (*T. compactum*) and Indian wheat (*T. sphaerococcum*), as also the lax-eared Bread wheat (*T. vulgare*), were at one time supposed to have emerged in central Asia, where a gene-centre can be identified. Their origin was ascribed to chromosome aberration in Emmer. Percival[11] has suggested that Goat-face grass (*Aegilops sp.*) was involved in a hybridization with Emmer, and consequently the supposed place of origin has been shifted towards the west, to the Transcaucasian theatre, where the areas of Emmer and *Aegilops* overlap.

The beginning of the cultivation of hexaploid wheats is not clear. Nowhere has a Neolithic culture been encountered based upon Naked wheats (which may be tetraploid or hexaploid), and so far their traces occur most frequently in Europe as insignificant admixtures with Emmer and Einkorn.

Whenever it has been possible to identify the actual variety with certainty, in other words whenever internodes or glumes were available for study, Naked wheat has proved to be the dense-eared hexaploid form, Club wheat.

The earliest deposits containing Club wheat are Neolithic Omari in Egypt,* a few Chalcolithic finds in Asia Minor, and the Bronze Age finds at Harappa in India. In European Neolithic deposits it is met with from the Danube Basin to Denmark, but only in the Swiss lake dwellings[2] was it found to any large extent. Here more or less complete spikes were discovered. During the Bronze Age we find Club wheat sporadically all over Europe. In the Iron Age, however, it began to acquire real importance at the same time as Emmer was given up generally. Thus, in Roman deposits in Britain a Naked wheat occurs in bulk together with Spelt,* and in Denmark the same type is encountered about the birth of Christ,* both undoubtedly being Club wheat. On the Continent the

dense-eared Club wheat seems to have been replaced by the lax-eared Bread wheat at the beginning of historical times. To-day dense-eared wheat is mostly grown in Asia, but like other old-fashioned cereals it has survived in mountainous central Europe too.

Spelt (*Triticum spelta*) is perhaps the most perplexing of all our cereals. This species is hexaploid. Morphologically it is a Glume wheat with a somewhat brittle axis and with its grains jammed into its sturdy spikelet structure. Nearly a hundred years ago the first prehistoric Spelt was excavated in Bronze Age deposits in Switzerland.[2] Further finds were made in that country and in neighbouring tracts of Germany.[8] During the last fifteen years its occurrence has been established in Iron Age Alsace and the Late Bronze Age* to Roman periods in England. Recently it has even been identified in bulk in a Late Iron Age grain find from Gottland[10] in the Baltic and in Bronze Age deposits in Denmark[12].

The Romans are known to have appreciated Spelt to such an extent that they organized Germanic agricultural settlements in North Italy in Late Imperial times.[13] Even if the Romans were not responsible for the introduction of this cereal into England, as it appears to have arrived several centuries before Caesar, the finds indicate that they did appreciate it in this country too.[9] It must have been grown extensively during their occupation.

In recent times Spelt is but sparsely cultivated, for instance in certain parts of northern Switzerland, southern Germany and the Eifel-Ardennes district. Some isolated centres of cultivation in Spain and south-eastern Europe may be explained by groups of German immigrants who, centuries ago, took their favourite cereal with them to their new homes.[13]

Explanations of the phylogenetic origin of Spelt were put forward at a time when prehistoric finds were restricted to the small central European area, and they were strongly influenced by this circumstance.[14] It was suggested that Spelt emerged in the northern Alps and indeed by hybridization between Emmer and Club wheat, both of which were notably grown in Switzerland at the suggested time, middle of second millennium B.C. Also chromosome aberration in Club wheat has been suggested. Even the co-operation of the Oriental Goat-face grass (*Aegilops*) has been invoked,[11] but this theory is being given up for geographical reasons for the time being. As a matter of fact, the idea has its attractive aspects, as the mode of articulation is exactly the same in this grass and in Spelt. Future archaeological research may easily increase the prehistoric range of Spelt, and we may then have to reconsider our conception of its origin.

The name of Spelt seems to be of Germanic origin, and it has spread to Latin and all western European languages. Because of the external similarity of Einkorn, Emmer and Spelt, the name is applied almost arbitrarily to any

of them, thus creating the most deplorable confusion in literature and statistics. Modern plant geography has done a great deal to clear up this matter, but older literature is rather unreliable on account of this ambiguity.[3]

All the species hitherto described are believed to be related to *T. dicoccoides* in some way or other. Only one cultivated species cannot be related to this pedigree. Einkorn (Small Spelt, *T. monococcum*), the only cultivated wheat which is diploid, is evidently a descendant of the wild *T. aegilopoides*, which is believed to be related to the Goat-face grasses of the Near East.

Einkorn belongs to the Glume wheats, having the same sturdy construction of its spikelet and the rather brittle axis (rachis). Whereas Emmer and Spelt normally develop two grains in the spikelet, Einkorn usually bears only one.

Although morphologically attached to Emmer and Spelt, this species proves quite independent in biological behaviour. Whereas among most other *Triticum* species it is very easy to produce fertile hybrids, it is next to impossible to cross Einkorn with any other wheat. Owing to this circumstance it has been left out of most phylogenetical theories.

The wild Einkorn is distributed in one variety in the Balkans and in another from Asia Minor to Palestine and Persia. It grows together with wild Emmer in some areas, and it is rather difficult even for botanists to discriminate between them in a mixed crop.[15] It is conceivable that the first agriculturalists did not pay too much attention to the slight difference in size, and thus Einkorn may have been brought up unintentionally together with Emmer. Only later was it picked out as a crop on its own. Even allowing for the difficulty in discriminating between the carbonized grains of the two species in prehistoric deposits, one gets the impression that Einkorn was always a cereal of little importance compared with Emmer, and that at least in northern and western Europe it was never cultivated separately.

Early Bronze Age Troy, in western Asia Minor, is one of the very few localities where Einkorn evidently occurs in quantity together with Emmer. Owing to the difficulty of discrimination, however, the relative importance of Einkorn has not been established.[16] Associated with Emmer it is further encountered in numerous Neolithic sites along the Danube, in central and western Europe, and in Britain and Denmark. It occurs sporadically throughout the Bronze Age and even persisted as late as the first century A.D. in Bornholm in the Baltic.* Its present cultivation is restricted to Asia Minor and small areas in central Europe, Spain and the Balkans.

The discovery at Troy, combined with a centre of multiplicity of the wild varieties in Asia Minor, inspired the idea that Einkorn was first cultivated in Asia Minor. This idea seems to be based upon rather circumstantial evidence. In the first place, the Troy grain, found some seventy years ago, cannot be considered as satisfactorily investigated. Secondly, a find like this one, of the

middle to late third millennium B.C., can hardly be regarded as indicative of the origin of a species which about that time had already spread to northern Europe. Thirdly, the species has been established in the east for periods much earlier than Troy. Impressions of Einkorn have been identified in Chalcolithic layers in Hama in Syria,* dated to the fourth millennium, and in Jarmo, too, carbonized grains were found undoubtedly belonging to this species. This shows that Einkorn accompanied Emmer already at that time and thus its cultivation long before Troy is demonstrated. Incidentally, the finds from Hama and Jarmo tend to show the precariousness of the claim, continuously maintained, that Einkorn was foreign to the Semitic area. Recently the species has been reported from Neolithic Egypt, too, but this identification should be treated with considerable reserve.

Barley

As mentioned before, the two cereals wheat and barley occur together in practically all early grain deposits in Mesopotamia and Egypt. Together with wheat, barley was introduced into Europe, and the very first traces of agriculture even in northern Europe bear evidence of this cereal (Plate I).

As is well known, the genus *Hordeum* is classified in two main groups, the two-row and the six-row types. Six-row barleys are further divided into lax-eared and dense-eared forms. In all the cultivated groups naked as well as hulled forms occur. It should be pointed out that in the hulled forms the pales are organically attached to the surface of the grain as opposed to the Glume wheats and oats, in which the grains are held mechanically within the flower by the stiff glumes or pales. No threshing, however violent, can remove the pales of hulled barley, but in carbonized material the pales very often have disappeared in consequence of heat and wear.

The two principal forms of six-row barley, *H. hexastichum* and *H. tetrastichum*, appear to be equally old in the Oriental finds. In Neolithic deposits from eastern and central Europe and Sweden the dense-eared form, *H. hexastichum*, seems to be universal or at least predominant, but in other Neolithic finds, as for instance from Denmark and Britain, the lax-eared form has been identified, whereas the dense-eared barley was not recognized. In British finds of the Bronze Age and later periods both forms are met with.[9] To-day dense-eared barley is cultivated in Europe only in restricted areas, as for instance in the Alps, central Sweden and the Faroes.

Two-row barley is reported from a number of deposits in the Orient and Europe dating from the Neolithic and onwards. In several cases, however, the documentation is far from satisfactory. Often attempts are made to establish the species on the evidence of grains alone, but it would seem necessary to

have something more to show, as for instance internodes and, preferably, the reduced lateral flowers.

In Jarmo in Iraq several impressions (Plate II, 4) and also many carbonized parts of the inflorescence of two-row barley are met with.* The grains are hulled, long and slender, and taper evenly towards both ends (Plate III, 2). The pales are not wrinkled. In three of the carbonized grains part of the internode and one of the lateral florets are preserved *in situ*, and the impressions also show the reduced florets. Several axis fragments, long and parallel-sided, were recovered, and occasionally the bases of the lateral florets are preserved. (Plate III, 3). It is a conspicuous feature that in two instances the axis fragments consist of three internodes together which indicates that the axis was not brittle. A brittle axis would not present unbroken joints after carbonization, excavation many millennia afterwards, transport, and handling in the laboratory. Considering the fact that the hulled grains show a close conformity with the wild species *Hordeum spontaneum*, the toughness of the axis is important, as in all genuinely wild barleys it is more or less brittle. One of the most interesting points of correspondence with *H. spontaneum* is the fact that the lateral spikelets are pedicellate, not sessile as in cultivated varieties. Not the slightest trace was found in Jarmo indicating six-row barley. In another of Robert Braidwood's Mesopotamian sites,[7] Matarrah* of the Hassuna stage, the same type of long straight barley grain was universal.

It has often been pointed out, and quite rightly, that hitherto we have never encountered cultivated cereals corresponding in their finer characters to the wild species. This has been taken as an indication of a long span of time from the start of agriculture to the Neolithic communities which have provided the earliest known agricultural products. In the case of Jarmo, however, we appear to be faced with a cultivated barley morphologically very close to the wild one. The distinguishing marks are just the greater volume of the grains and the tough axis. Thus for the time being we cannot claim the earliest barley known to be of six-row type, and it will be interesting to find out archaeologically when and where the six-row barley joins forces with the Jarmo barley.

This question takes up a central position in the study of the phylogeny of the species. It should be possible by means of archaeological material to show the survival of the Jarmo barley and its derivatives, and possibly to ascertain the genetical connection with modern two-row forms. It is desirable that closer attention be paid to this point and that better documentation be published. Especially would we urge excavators to take the utmost care in recovering carbonized specimens of plant material so that we can have more parts of the plants than just the grains.

The cultivated as well as the wild barleys form a comparatively uniform morphological group. In spite of this circumstance it has been extremely

difficult to agree upon certain views regarding the origin of the cultivated species.[18] It has been proposed that a two-row wild form, preferably *Hordeum spontaneum*, was the common progenitor of all barleys, and it has alternatively been suggested that a six-row form was the common ancestor, one of the main arguments being that the six-row barley was the first to be cultivated, an assumption which till recently had been justified by archaeological finds. The recent discovery of an allegedly wild six-row species in eastern central Asia, described by Aberg under the name of *Hordeum agriocrithon*, has added fresh fuel to the fire.[18] At present it seems as if the six-row progenitor is in general favour with most geneticists.

According to Vavilov's gene-centre theory, the home of the cultivated barleys would be the Abyssinian mountains and south-eastern Asia. A great number of different varieties occur in these areas. But it has been pointed out by Schiemann[6] that the variation in all prominent characters is the same in these two widely separated regions, and that in all probability the original cultivation centre should be looked for just between them.

The discovery of the Jarmo barley supports this conception. Jarmo lies within the present range of distribution of *Hordeum spontaneum*, which species is lacking in Vavilov's eastern gene-centre. On the whole it must be admitted that as far as barley is concerned Vavilov's theory looks at the moment somewhat improbable, in spite of the find of *Hordeum agriocrithon* in south-eastern Asia.

Freisleben[19] thought that the emergence of the cultivated two-row barley was due to crossing between *H. spontaneum* and an *agriocrithon* type, but it does not seem necessary to postulate a hybridization for the Jarmo barley, especially as its lateral spikelets are still pedicellate as in the wild two-row species. The tough axis is not unheard of in *H. spontaneum*, though of course it would be a recessive and disadvantageous character in a purely wild species. As soon as the species was cultivated, "tough axis" would automatically turn into a property of first-rate selective value and acquire dominance under human attention.

The idea that the six-row inflorescence is the primary one and the two-row a reductional form[20] and therefore later sounds reasonable enough and agrees with corresponding viewpoints in other natural sciences, but the development may be of a date vastly earlier than the time when man appeared on the scene. The Jarmo barley is our earliest factual basis concerning the development of cultivated barley, and future theories will have to be adjusted to it.

A problem of far-reaching importance for our understanding of cultural relations in the early Neolithic is the explanation of the occurrence of Naked barley in the North European Neolithic. This form, which was defined by Knud Jessen[21] and compared with *Hordeum coeleste*, belongs to a group of

barleys that is mainly cultivated in southern and eastern Asiatic countries. Many deposits of carbonized grain from the Orient and Europe have been described as containing or consisting of this form, but as a clear description of the morphology has not been offered, it is impossible to decide whether there has actually been found genuine Naked barley in prehistoric Europe outside France, Britain, Belgium, Holland, Germany, Scandinavia and Poland.[22] Most carbonized hulled barley has lost its pales in the process, and a close study is required to determine whether the grains were originally hulled or not. Descriptions concerning paleless carbonized barley from Egypt do not indicate an originally Naked form, and my personal experience of barley from Hama in Syria,* comprising very many impressions from the Neolithic to Late Iron Age, as well as fair amounts of carbonized grain, does not include one single case of Naked barley. Nor have I seen it in the Mesopotamian finds. One of the important tasks for future research is to define where and when Naked barley occurs in Europe, and then to find out from where it came and along what route. According to our present knowledge this form does not seem to have been carried along the route which has been suggested for the great Neolithic migration from Mesopotamia towards the Mediterranean and further west.

Naked barley is supposed to have been segregated by mutation from cultivated hulled forms. Did the naked barley pass through the Caucasus, or did the mutation happen in Europe as well as in the Far East and Abyssinia?

Millets

In Neolithic and later strata in Europe grains of *Panicum* are met with. Only two species[23] of this large and widespread genus have been identified in quantity, Common panicum (*Panicum miliaceum*) and Italian millet (*Setaria italica*).

The two species occur together in many finds, but it seems as if *Panicum* was the commoner in the Neolithic as it has been identified in the Ukraine, in Thrace, along the Danube, in Switzerland, Germany and France. In Bronze Age deposits it further occurs in Rumania, Holland and Denmark. Especially in Holland very many impressions have been found,* increasing in number during the Iron Age. Even the Romans used this cereal in Italy as also in central European provinces. Strangely enough, it has not been identified in Britain.

Italian millet seems to have preferred the southern European climate. It mainly occurs in finds of Neolithic and later dates from Italy, France and central Europe. However, a recent find of the species in late Iron Age Bornholm in the Baltic shows that it could endure colder climates.*

Morphologically Italian millet is related to the wild species, Green millet

(*Setaria viridis*), which is distributed in western Asia and along the Mediterranean and occurs as a weed all over Europe, even in England and as far north as Finland. Whereas it seems probable that Green millet is the progenitor of Italian millet, the claim that this species is the progenitor of Common panicum is more questionable. The Abyssinian wild species, *Panicum callosum*, Hochst.,[24] displays a strong morphological likeness to Common panicum, but this matter has never been thoroughly investigated. In particular the geographical angle seems difficult to explain.

In our days panicum and millet are being grown in Europe only in the south and east, and they are unimportant. In India and the Far East they are of considerable importance as food grain, and the cultivation of panicum is of great antiquity in China. In ancient texts it is mentioned as one of the five cultivated plants which were subject to certain rituals.[25] This suggests an old standing in Chinese agriculture. No early finds of panicum are reported hitherto from the Middle East, but it would seem probable that it was grown somewhere between China and the Danube basin in prehistoric times. We shall just have to find it.

Rye

As opposed to the plants hitherto considered, two cereals of major importance to modern civilization have a comparatively short history as cultivated plants. Rye and oats are believed to have penetrated into the cultivated fields of wheat and barley and to have first turned into weeds, and only under certain circumstances have they afterwards been acknowledged as profitable subjects for cultivation. They may be called secondary cultivated plants.

Rye has been reported from Germany[20] in deposits of early first millennium B.C. In Denmark it occurs about the beginning of the Christian era. In the Roman period it was cultivated in Switzerland and Hungary, too, and it is met with in Roman deposits in Britain among other cereals. Here, however, there is no indication as to its cultivation as a separate crop until the Middle Ages. It was carried across the Alps and to Greece by the Romans, but it never gained importance in these countries. To-day it is mainly grown in France, Germany, northern and eastern Europe and the Soviet Union to the Pacific.

Rye is practically self-sterile, and this circumstance has kept the species within rather narrow morphological boundaries, tending to produce a uniform average type. In wheat fields of western central Asia is distributed a group of closely related weed grasses comprised under the name of *Secale montanum*. This species varies much in the brittleness of the axis. Up to quite recently it was considered the progenitor of the cultivated rye, but as brittleness is no

universal character in the species, and as it further occurs as a weed, it can perhaps not be considered a plant perfectly independent of human activities. When twenty-five years ago a genuinely wild and definitely brittle species, *Secale ancestrale*,[26] was found in Asia Minor and Afghanistan, it was realized that in a species like this one we may see the progenitor of the cultivated rye as well as the western Asiatic weed rye.

Because of its greater resistance to winter cold as also its more modest demands on the soil, the weed rye attains a better development as compared with the host crop, when wheat cultivation is moved upwards in mountains, farther north, or to light soils. In this way it happened that under its migration from western Asiatic regions to areas of greater altitude or towards the north, the wheat declined in output simultaneously with an increase in richness of the rye. At some point the peasants would find more rye than wheat after threshing, and the final stage would consist of the selection of rye ears for seed corn for a separate crop. This did not happen in the east. The earliest finds of cultivated rye are those mentioned for east and central Europe, and no traces are encountered within the Anatolian–Lower Danubian area. Comparing the two facts, the occurrence on a large scale of weed rye in western central Asia where rye is not being cultivated on the one hand, and the earliest occurrence of cultivated rye in eastern and central Europe on the other, the conclusion seems inevitable that the rye has arrived in Europe along its own road. This probably went across the Caucasus and the Russian steppes north of the Black Sea. It was presumably in the winter-cold regions of the European continent that rye attained the rank of a cereal on its own.

Oats

Like rye, oats appear in deposits of early first millennium B.C., or even earlier, but whereas rye of this period is restricted to central and eastern Europe, oats are met with rather frequently in Danish Bronze Age[27] finds too. Judging by large deposits of carbonized grain it appears to have been cultivated separately in Iron Age Denmark. Two recent finds of the Late Iron Age in Bornholm and Gottland* in the Baltic, on the other hand, contain among the wheat and barley up to 2 per cent of the wild oat, *Avena fatua*. Cultivated oats, however, were not established. In central Europe and Britain Roman period finds show that the Romans utilized this cereal to a certain extent. In the Mediterranean area and the Near East we have no evidence of its cultivation, and the species is mentioned for the first time in literature by Greek authors in late first millennium B.C., and then only as a fodder plant.

The origin of oats is somewhat complex. Evidently more than one species must have given rise to the cultivated varieties, and it may also be supposed

that cultivation started independently in more than one area. The Bristle-pointed oat is grown only in western Europe and would be a descendant of a variety of *Avena barbata,* which is indigenous to a region extending from Armenia along the Mediterranean and the Atlantic coast, perhaps even to Britain. The most widely cultivated oat, *Avena sativa,* is considered to have developed from the wild *Avena fatua,* which is distributed in western Asia, North Africa and eastern Europe.

As a weed the wild oat invaded the cultivated fields, especially the wheat fields, and was distributed with agriculture into areas of climatic conditions less suitable to wheat, and here oats were chosen for separate cultivation, natural selection being supplemented by human endeavours. It seems probable that this process happened in Europe. Various species of oats are being cultivated all over Europe, temperate Asia, North Africa and America.

Many other plants were cultivated at an early stage of agriculture, as for instance the vine, flax, peas, lentils and other legumes, but it would take us too far afield to go into their history in a single brief lecture. The cereals are in any case by far the most important, and they are the plants which have experienced the most amazing development under human care.

I hope I have made it clear that the plant material excavated and dated by archaeologists is of the greatest value, not only to cultural history but also to biology. This circumstance places the excavator in a position of special responsibility. No plant remains, however trivial, should be discarded in the field, but should be recovered with meticulous care and subjected to expert examination. It should be stressed once more that the carbonized cereal grains themselves are not always sufficient, but that the black earth in the surroundings of grain deposits may contain invaluable evidence of identity. Unfortunately there can be no doubt but that much interesting plant material has been thrown away during the excavation of many of the most important prehistoric sites. In my opinion it should be possible to produce plant remains from most of the larger prehistoric habitation sites.

Properly dated and thoroughly morphologically defined, the actual plant material will remain the solid foundation upon which all phylogenetic reasoning must be built up. Without such a foundation all theorizing is bound to be futile. But we should always try to keep in mind that new finds of plant remains may alter the picture, and that any view held is perhaps final to-day but not necessarily to-morrow. So much is happening in the various branches of research covering the early history of plant breeding—not least in archaeology—that it appears perfectly possible that eventually, by the pooling of all available forces, we shall be able to expose the actual progenitors of the cultivated plants.

PLATE I

Wheats and Barleys

Facing page 58

PLATE II

(1)

(2)

(3)

(4) [*Photo H. Helbaek*

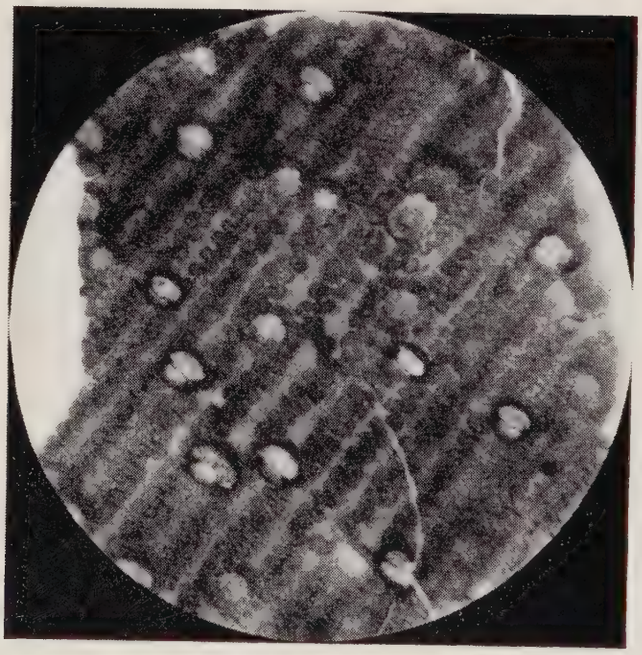
1. Dorsal side of Jarmo wheat spikelet (cast) compared with Neolithic Egyptian Emmer. 3 diam. 2. Ventral side of Jarmo wheat spikelet (cast) compared with Neolithic Egyptian Emmer. 3 diam. 3. Ventral side of Jarmo wheat spikelet (cast) compared with recent *T. dicoccoides*. 3 diam. 4. Impression in clay of ventral view of barley triplet, Jarmo. 4 diam.

PLATE III

(1)

(2)

(3)



(4) [*Photo H. Helbaek*

1. Jarmo carbonized grain. Upper three Einkorn, the rest Emmer. 4 diam. 2. Ventral side of Jarmo barley. Note lateral florets. 4 diam. 3. Axis (rachis) fragments of Jarmo barley. Note pedicels of lateral florets. 4 diam. 4. Distal epidermis of barley pale, Jarmo. c.235 diam.

[*Photo Ellebé*

The Beaker from Dennemont

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(3) Diploid cells contain two sets, tetraploid four sets, hexaploid six sets, of seven chromosomes.
"Spelt," which is hexaploid, must not be confused with "Small Spelt," which is diploid. For this reason the term "Einkorn" is to be preferred to "Small Spelt."

(4) The technical terms used for the parts of the wheat spikes are explained in Figs. 1 and 2.

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A Grave Group with Beaker from the Paris Basin

By G. de G. Sieveking

The Gallery Grave of Les Mureaux, excavated and published by Dr. Verneau in 1890[1], deserves re-examination in view of the developments of the last fifty years, for it contained undoubted sherds of Bell-Beaker pottery, a type otherwise scarcely known in the Paris Basin, and found here in association with S.O.M. grave furniture.

The grave-group to-day forms part of the collections of the Musée de l'Homme, Paris. Thanks to the admirable organization of the Department of Prehistoric Research, and to the courtesy of Mr. Harper Kelly, in charge of this department, and Dr. Vallois, the Director of the Museum, I have recently had the opportunity of re-examining the material. The drawings were prepared by M. Humbert, one of the official draughtsmen of the Museum.

Pottery

There are five complete vessels in this grave-group (Fig. 1). The first four are characteristic S.O.M. flower-pot vases, a type well known in the Paris Basin.[2] These (Fig. 1, 1–3 and 5) have flat, splayed bases, and everted rims. They are made of a coarse gritty paste, poorly fired, reddish brown to grey in colour. This coarse ware should be regarded as a degenerate form of Western Neolithic pottery. The slack profile and applied flat base is an expression of this degeneration, perhaps produced by culture contact with the makers of more highly evolved wares. The fifth vessel is of a different type (Fig. 1, 4). It has a markedly carinated shoulder, an everted rim, and a semi-omphalos base. The ware is smooth and well fired, and the paste is fine and black in colour. This may perhaps be considered a Late Bronze Age intrusion, on the grounds of a general resemblance to French Urnfield pottery. Childe, however, has suggested that it has vague affinities to the Western Neolithic group[3] and, though it is difficult to find French analogies, it can be compared in some respects to a vase from the Fontenay-le-Marmion passage-graves in Normandy[4] and to fragments of vessels from the "chalcolithic" horizon at the Pinnacle settlement in Jersey.[5] These vessels, which are a variety of the so-called Jersey bowls, have the same markedly carinated shoulder and omphaloid base. The ware is similar to that of the vessel which we are describing, and it is

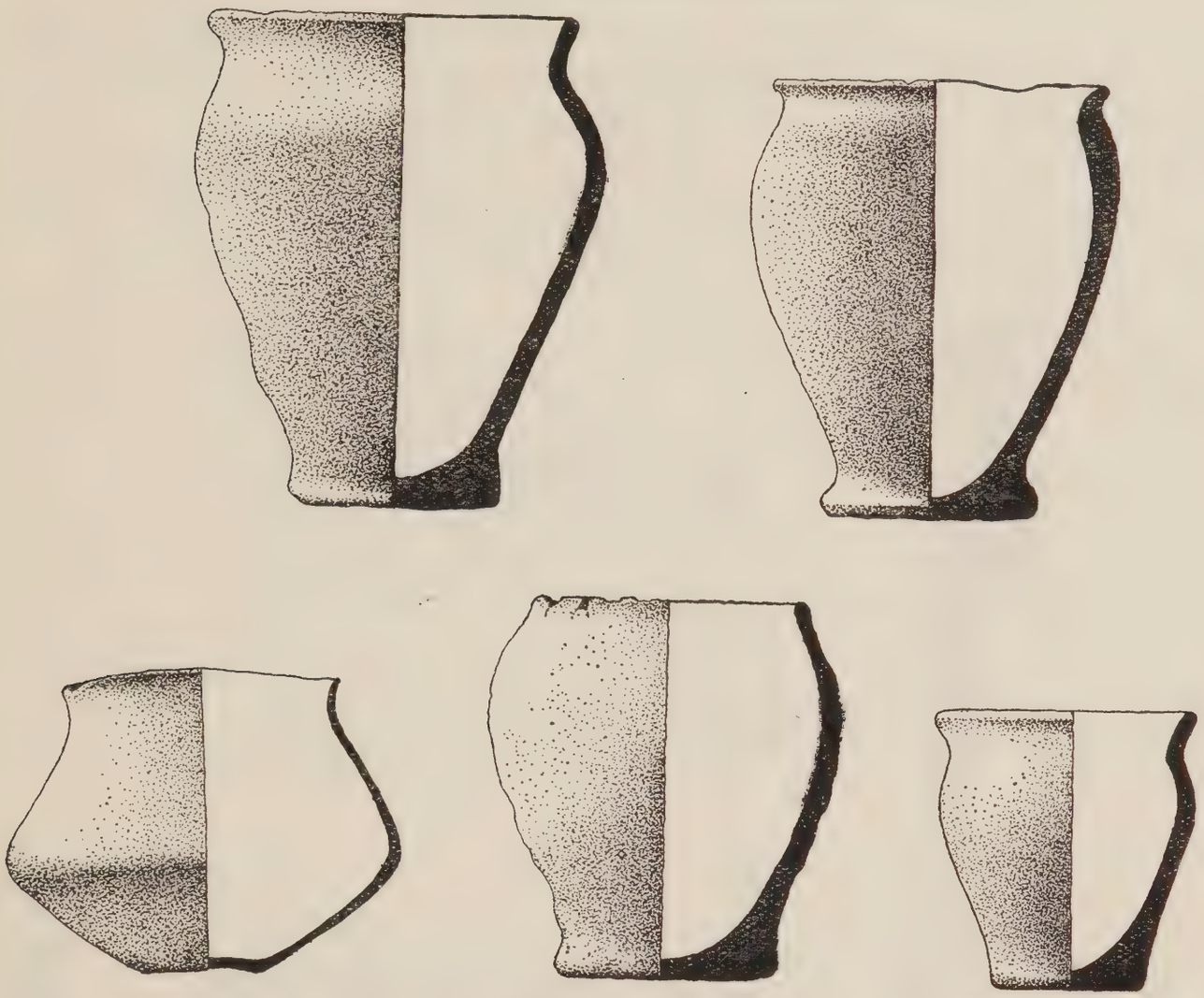

FIG. 1. Pots from Les Mureaux, $\frac{1}{4}$

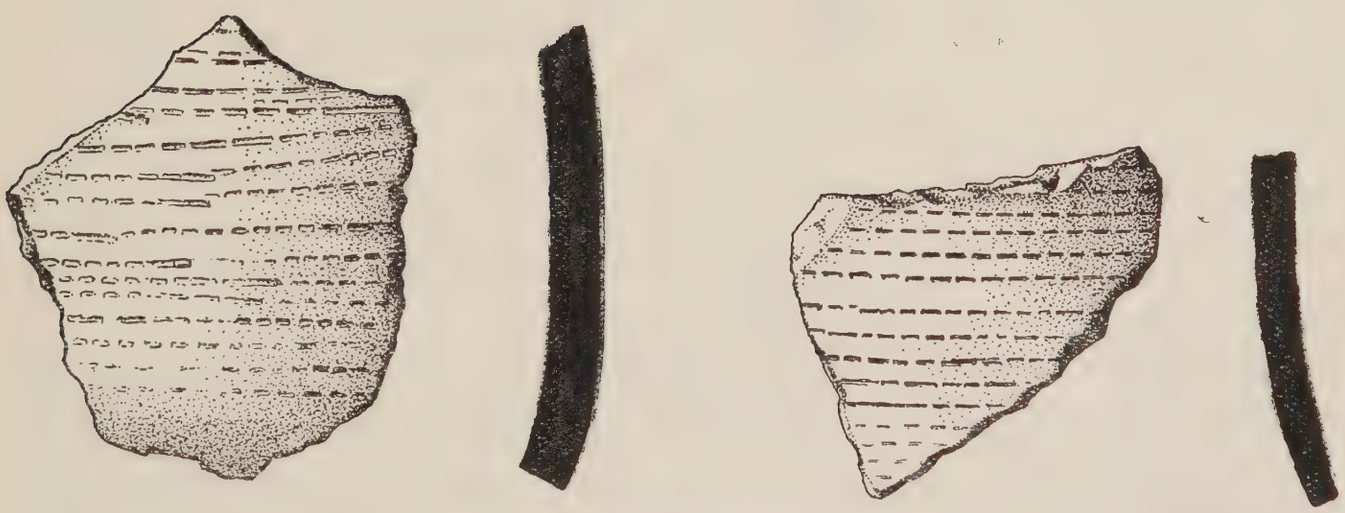

FIG. 2. Beaker sherds, $\frac{1}{2}$

perhaps significant that Godfray and Burdo describe them as derivative forms of Beaker pottery. The Fontenay-le-Marmion vessel also possesses a semi-omphalos base, which can be regarded as a Beaker characteristic in Atlantic Europe at this period.

Most important of all, the grave-group contains four sherds of typical Bell-Beaker pottery, the two largest of which are illustrated in Fig. 2. The

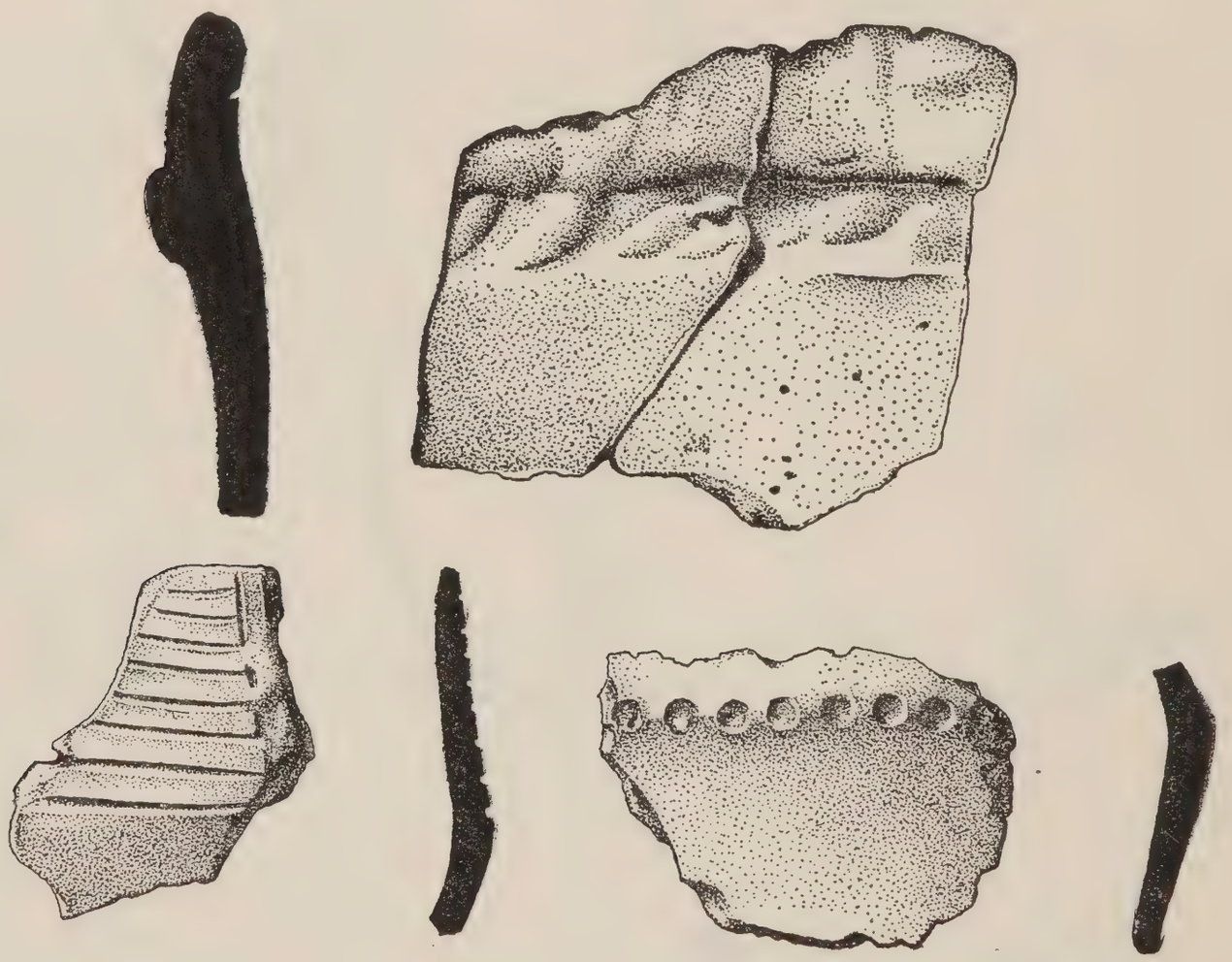

FIG. 3. Sherds from Les Mureaux, ½

ware is excellent light red Beaker, perhaps slightly thicker than in British examples,[5a] and the sherds all appear to form part of the same vessel, which seems from the definite contour of the sherd sections to have had the typical S-shaped profile of the Breton Bell-Beakers.

Among the other sherds in the collection, the most important is the large fragment of finger-printed cordoned ware (Fig. 3, 1). It is made of coarse grey fabric; the pot wall is thick and strong and the surface well finished. This sherd may have formed part of a large storage vessel, but the paste is easily distinguished from that of the flower-pot vases, the normal food storage

vessels. Professor Childe and Miss Sandars recognize this finger printed cordoned ware as forming part of their Seine-Oise-Marne complex.[6] However it is more typical of the Horgen culture in Switzerland and the Chalain and Clairvaux lake settlements, and we are tempted to regard it as a direct Swiss import. Pottery of this variety is known from the Yonne,[7] the East French caves, the Charente[8] and the Narbonne region.[9]

Two other sherds from the Les Mureaux grave-group are also illustrated. The first is the rim of a small vessel made in fine smooth brownish-black ware (Fig. 3, 2), which is decorated in deep channelled lines. It seems likely that the decoration was confined to small blocks of parallel horizontal lines round the neck of the vase, perhaps alternating with blocks using some other motif. This form of decoration is reminiscent of that used on one of the vases from Conguel, Morbihan, in Brittany.[10]

The second sherd (Fig. 3, 3) is made in a thicker whitish ware. This is regularly decorated with a series of even stabs made with a cylindrical object before the vase was fired. I regard this sherd as belonging to the Late Bronze Age wares, usually grouped together in France as Urnfield pottery. Some sherds from Écury-le-Repos, Marne, now in the Musée de l'Homme, are decorated in the same manner.

Stone and Flint

The stone and flint objects from the Les Mureaux grave-group, though there are some fine specimens among them, do not need the same close attention, since the details are sufficiently well shown by the illustrations.

The two lanceolate blades (Fig. 4, 1–2) are made of light honey-coloured Pressigny flint, the variety best known from the working site of La Claisière, Grand Pressigny. In workmanship they are typical of the *belles pièces* from the Seine-Oise-Marne gallery graves. They have a relatively flat section, and are specially trimmed at the base for hafting in a wooden handle. These blades are parallel-sided with light flaking which runs back from the specially made point at the working end, and are of a type found in pairs or larger numbers, accompanying burials in the Paris Basin and Western France.[11] They probably mark a male burial, and I have no doubt that they both belonged in this case to a single interment.

The single transverse arrowhead is a good example of the variety found in the gallery graves and rock-cut tombs of the Paris Basin. It is probably *not* manufactured by the micro-burin technique. Seven hundred transverse arrowheads of this variety were found in the Marne grottos, and are now in the collections of the St. Germain Museum. Lanceolate and barbed-and-tanged arrowheads have also been found in the S.O.M. gallery graves.[12]

The arc or segmented pendant (Fig. 4, 4) found here belongs to the smaller and thinner of the two types found alike in the S.O.M. classic area, and in the Charente, Brittany and the Channel Islands.

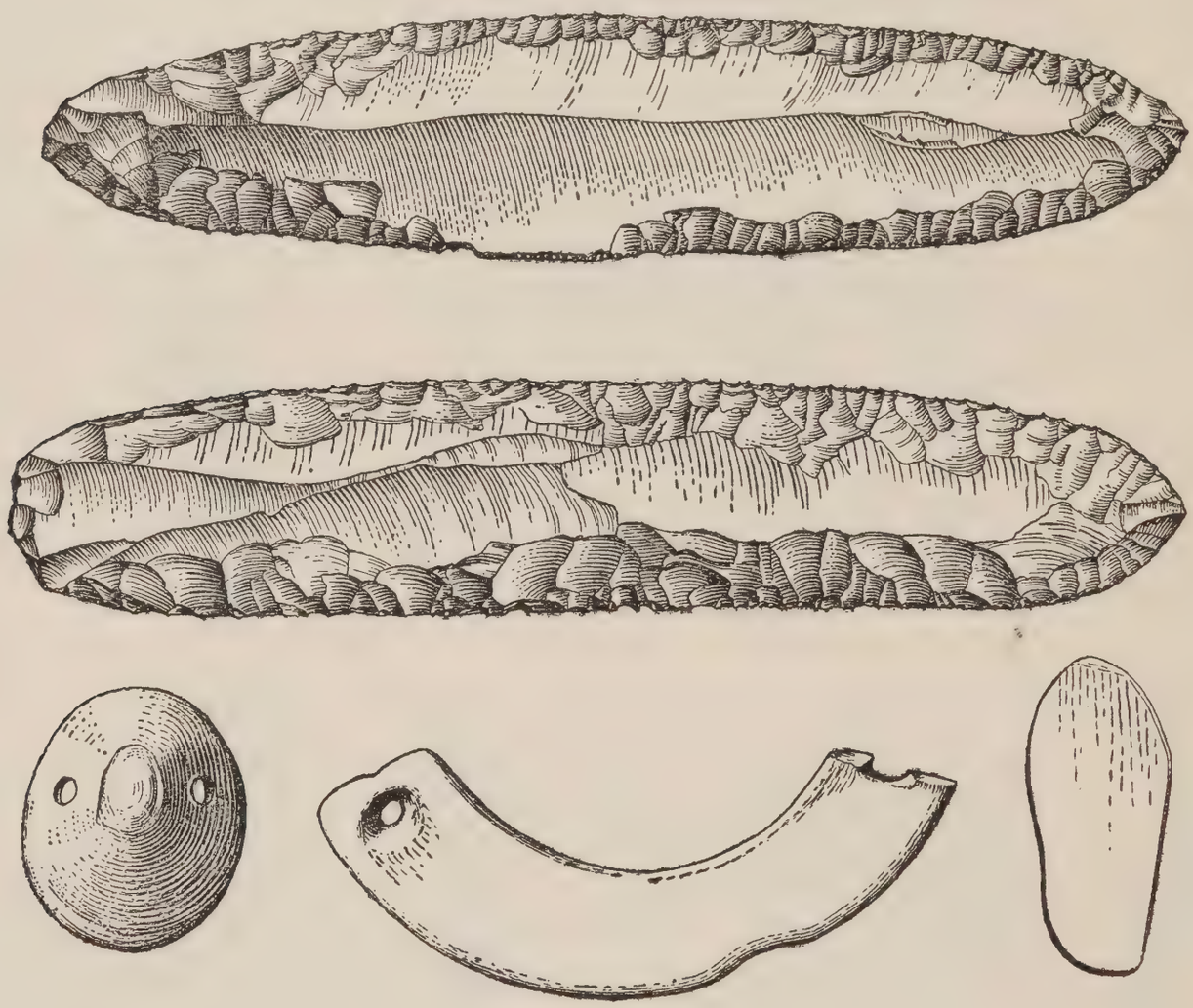

Fig. 4. Flints, shell, arc pendant, bone object, ½

Further Associations

Two objects from this grave-group remain to be discussed. The first is a limpet shell which has been pierced in the manner of a V-perforated button (Fig. 4, 3), and, as it is here associated with a beaker, we may be allowed to regard it as such. Though no complete study of the use and manufacture of these interesting objects has yet been made, it is recognized that there is considerable variation in design and raw material. Finally, we illustrate a small piece of bone, perhaps a fragment of a human skull, though this cannot be proved, as its edge has been carefully polished (Fig. 4, 5). This may be a cranial

amulet similar to those known from S.O.M., and other secondary Neolithic associations in France.[13]

Discussion

It is apparent that the main interest in this grave-group lies in the association of Bell-Beaker pottery with vessels typical of the S.O.M. culture. It need not be stressed that this association is unproven, since successive interments are well known from the Paris galleries. However, the cultural implications of this grave-group merit consideration.

Few complete S.O.M. flower-pots have been recovered from the gallery graves. The main collection available for study comes from the rock-cut tombs excavated in the Marne valley by the Baron de Baye and now in the St. Germain Museum. The majority of these are large food-containers with approximately the same range of size as British Cinerary Urns. However, fragments of this pottery are known from many of the Paris galleries, and may presumably be connected with their first occupants. Such pottery has been documented by a series of scholars; and Professor Childe and Miss Sandars in their recent summary give a clear statement of its cultural associations in this area as well as indicating its distribution to the Atlantic coast of France.[6] Dr. Arnal and Dr. Nougier have recently shown that it is to be found south of the Massif Central. A good S.O.M. association was recently excavated from a megalithic cist at Bec-des-deux-Eaux, Indre-et-Loire, on the edge of the Pressigny flint workshops. This contained five S.O.M. flower-pot vases, a perforated antler haft, a transverse arrowhead and an antler-hafted knife of Pressigny flint with a transverse blade.[14]

The chronological position of this class of pottery in France has not yet been defined. Professor Vogt, following the suggestions of Professor Childe and Mrs. Hawkes, has confirmed the resemblance of S.O.M. flower-pot vases to those in the Horgen culture in Switzerland, as well as to similar vessels found in Swedish gallery graves.[15] However, despite other direct Horgen connections, such as the finger-printed cordoned pottery, and perforated antler hafts, the floruit of the S.O.M. pottery cannot have coincided with that of the Horgen culture. Grand Pressigny flint, which is associated with the S.O.M. pottery, is not known in Switzerland before the Æneolithic (Vouga IV)[16] and has a conclusively "Late-Beaker" date in western Europe. Professor Mariën in a recent paper has emphasized the mutually exclusive distribution of Beaker and S.O.M. pottery in Belgium, and the direct continuity of this S.O.M. area with that of the Paris Basin.[17] The Beaker distribution in France, like that of Belgium, is largely confined to the coastal regions. Thus the appearance of Beaker pottery in S.O.M. surroundings assumes a peculiar importance.

The sherds in the Les Mureaux collection are small and their decoration is of the simplest kind. In paste and in decoration they can be said to resemble the Breton and Portuguese groups, though parallels could also be drawn with English beakers. Sufficient material was not recovered from the grave to determine the form of the vessel, and thus its origin must remain a matter for conjecture.

Three other beakers have been found in the Paris Basin.[18] One of these, the Dennemont Beaker, was sufficiently complete to be reconstructed, and was also found in an apparently S.O.M. context. The Dennemont Beaker (Plate IV) is stroke decorated with horizontal bands diagonally hatched in both directions, a development of Savory's classical international Beaker style,[19] which is represented both in Brittany, the Channel Islands, and the British Isles. The Beaker has the squat shape, bulbous body and stout out-turned neck typical of the Jersey Bell-Beakers.[19a]

The Beakers in the Paris basin are isolated examples. They do not form a unified group, but probably represent not only different stages in the development of the Beaker styles, but also arrivals from different regions. Their appearance in an S.O.M. grave-group in the classic area, and the contrasting distributions of Beaker and S.O.M. pottery in France, suggest that the Paris gallery-grave complex should be dated to Late-Beaker times, which is further supported by the appearance of the V-perforated button technique at Les Mureaux. This is a technique scarcely known in Brittany,[20] though it is well known from Late-Beaker contexts in Portugal (e.g., Palmella, Alapraia, San Pedro do Estoril) and in Great Britain. In all, this evidence suggests that the S.O.M. wares represent a secondary neolithic comparable in date, relative to the Beaker expansion, to the English Food Vessels.

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(5) Godfray and Burdo, *Excavations at the Pinnacle*, 1950, p. 179, Fig. 34.
(5a) True Bell-Beaker ware in Portugal and Brittany is heavier than Wessex B 1, its nearest British relative.
(6) Childe and Sandars, *L'Anthr.*, 1950, pp. 1–18.
(7) Hue, *Le Sennonais Préhistorique*, 1922. Parat, *Bull. Soc. Sciences hist. et nat. de l'Yonne*, 1908.
(8) Bourgoise, Bois du Roc, Vilhonneur. Hand-coloured illustrations in the St. Germain Museum. Collection Faculty of Sciences, Poitiers.

(9) HELENA, *Les Origines de Narbonne.*
J. HAWKES, *Antiquity*, 1934, p. 39.
(10) CHILDE, *Prehistoric Migrations*, 1950, p. 87.
(11) For example:—
1 Argenteuil II, Seine-et-Oise, 16 blades.
MAUDUIT, *Arch. Rozh.*, Prague, 1949, pp. 76–9.
2 Collections of the Institut de Pal. Humaine, Paris.
Dolmen de Cuchet, Charente, 9 blades. Chauvet, *Bull. Soc. Arch. Charente*, 1869, pp. 773–80.
3 La Motte de la Garde, Charente, 11 blades, Museum Poictiers.
(12) CHILDE, *Arch. J.*, 1931, gives the percentages of the various types of Arrowhead found in these graves. See also Childe and Sandars *op. cit.* Appendix.
(13) PIGGOTT, *PPS.*, 1940, p. 112. Les Mureaux is No. 41 on Piggott's register of trepanned skulls in Europe. Fragments of 3 trepanned skulls are described in the original excavation report.
(14) MONTROT, *Les Amis du Musée préhistorique du Grand Pressigny*, Vol. I, 1951, p. 21.
(15) VOGT, *AfsA.*, 1938, p. 1 *seq.*
(16) Despite, A. LEROI-GOURHAN, *JSGU.*, 1948, p. 36.
(17) MARIËN, *Bull. Musées Royaux d'Art et d'Histoire*, Bruxelles, 1948, p. 41, and *L'Anthropologie*, 1952, p. 81.
(18) La Ferté Alais, Seine-et-Oise, *BSPF.*, 1945, p. 109 (fragments not illustrated).
Camp de Catenoy, Oise, Collections of the Musée de l'Homme (small fragments).
Dennemont, Seine-et-Oise, *BSPF.*, 1951, p. 283, and *Man*, 1928, No. 18.
(19) SAVORY, *Revista de Guimarães*, LX, 1950, p. 17.
(19a) HAWKES, J., *Arch. Chan. Islands*, Vol. II, Fig. 19 (good examples from Villes-ès-Nouaux); and Godfray and Burdo, *op. cit.*, Fig. 33.
(20) GIOT, *BSPF.*, 1951, p. 196 (the only recorded example in Brittany).
GUYAN, *JSGU.*, 1949–50, p. 163 (for general distribution excluding Brittany).

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